THE IMPERFECTLY DESCENDED TESTIS

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IMPERFECTLY DESCENDED TESTIS :

3ts Anatomy, Physiology and, Pathology.

BY

W. McADAM ECCLES, M.S. (Lond.), F.R.C.S. (Eng.)

ASSISTANT SURGEON TO, AND DEMONSTRATOR OF OPERATIVE SURGERY AT ST. BARTHOLO-
MEW'S HOSPITAL; HUNTERIAN PROFESSOR OF SURGERY, ROYAL COLLEGE OF
SURGEONS OF ENGLAND; EXAMINER IN ANATOMY TO THE SOCIETY OF
APOTHECARIES; LATE SENIOR ASSISTANT DEMONSTRATOR OF
ANATOMY ST. BARTHOLOMEW'S HOSPITAL; SENIOR ASSISTANT
SURGEON WEST LONDON HOSPITAL, AND CITY OF
LONDON TRUSS SOCIETY, ETC.

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PREFACE

THE chapters in this work embody the chief facts put forward in my Jacksonian Prize essay, and seeing that the subject of the imperfect descent of the testis is one that is engaging the attention of surgeons to a greater extent than formerly, I have considered that it may not be amiss to publish this small volume in the hope that it may prove useful. I have endeavoured to illustrate as far as possible the points that I deduce, and for this purpose I have introduced a number of original photographs, and at the same time have made use of some from other authors, which assistance I beg hereby to acknowledge.

I have also to record my appreciation of the kindness of those gentlemen who have generously allowed me to copy specimens and sections.

I have further to thank the Council of the Royal College of Surgeons of England for their permission to circulate this monograph, the manuscript of which, together with extensive tables and many other illustrations, will be found in the library of the College.

<div align="right">W. McADAM ECCLES.</div>

HARLEY STREET, W.
March, 1903.

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CONTENTS

ILLUSTRATIONS

[ix]

THE IMPERFECTLY DESCENDED TESTIS:

ITS ANATOMY, PHYSIOLOGY, AND PATHOLOGY.

CHAPTER I.

DEVELOPMENT AND DESCENT OF THE HUMAN TESTIS.

THE testis is the primary male generative organ. Its function is, therefore, to produce the male element necessary for reproduction.

As a more or less specialized organ it is present in all the vertebrata, and in some of the higher invertebrata. In the former it comes to be more complex in its construction, and in those types known as the mammalia it tends to migrate from its original place of development and pass towards the inguinal region. In the highest of vertebrates, including man, it normally transgresses the confines of the abdomen and the inguinal canal and enters the scrotum, there to remain, in the larger number of cases, permanently.

The testis consists of two parts—the testis proper, often termed the body of the organ, and the epididymis, or the excretory duct of the gland. These two parts are as distinct from one another in their origin as they are in their functions. The one, the actual formative gland, is derived solely from the genital mass of the fœtus, while the other is produced from the Wolffian body. How these two completely disjoined structures become connected together so as to mutually serve a physiological purpose is a matter of considerable interest and speculation.

It is not necessary to enter into detail as to the development of the human testis, but in order to understand its transit and its failure to reach its usual position, a short review of the formation of the testis and its descent is here given.

Development of the Human Testis.

The Wolffian body has an outstanding priority of appearance in the embryo, and the important function that it is destined to perform is heralded by its early deposition.

The embryonic connective tissue which participates in the constitution of the Wolffian body is found on either side of the primitive structure, running along the greater part of the length of the embryo and occupying a position at the posterior part of the pleuro-peritoneal cavity.

The masses of cells building up the bodies are themselves somewhat triangular in section, a shape which renders their recognition a matter of comparative ease. These bodies may be said to consist of cells differentiated and grouped to comprise glomeruli, tubules, and a duct. The exact origin of the cells which form the Wolffian body is fairly clear, but as to which cells of the structure afterwards produce the Wolffian duct is a matter which has led to much dispute. This is, moreover, a question of decided pathological importance. If it could be absolutely proved that their source of origin lay in the region of the epiblastic layer of the embryo, then the occurrence of certain epithelial new-growths in connection with the testicle could, perhaps, be better explained.

Originally the Wolffian duct is represented by a solid mass or column of cells. This is possibly derived from the epiblast, and possibly from the protovertebral or the intermediate cell mass, both of these latter being mesoblastic. There is nothing to support any contention that it is first formed from the hypoblastic layer.

The unhollowed column of cells erelong exhibits a cavity ; probably the cleavage which produces the body-cavity further acts as a factor in the formation of the lumen of the Wolffian duct. A subsequent point in the life-history of the

tube is its change of position with reference to the place
of union of the somatopleure with the splanchnopleure.
Originally found close beneath the dorsal epiblast, just
external to the somite, it appears to glide ventralwards, so
as to come to lie under the cellular elements of the lining of
the body-cavity. Here it is in direct relationship with a
mass of cells, which causes an elevation on the body-cavity
wall, and which in reality is the genital mass or ridge.

This alteration in situation is partly due to the growth of
the surrounding cell elements, partly to the flexure of the
embryonic layers, and partly to the increase in the number
and size of the cells participating in the formation of the
Wolffian duct itself. The significance of this change lies in
the fact that it brings the duct into proximity with the
genital mass, and thus paves the way for its future co-opera-
tion with it.

Next to the development of the Wolffian duct—first as
a solid column of cells, and later as a distinct tube—is the
formation of the Wolffian tubules and glomeruli, which sub-
sequently become apparent. The tubules are very numerous.
They begin as columns of cells derived from the intermediate
cell mass throughout the whole length of the Wolffian body,
and these columns are rapidly hollowed out, and then form
curved tubes. They are produced independently of 'the
Wolffian duct, a structure with which at a later period they
become connected. They constitute, when fully established,
definite tracts of communication between the primitive
peritoneal cavity and the cavity of the Wolffian duct.

The glomeruli appear at a time subsequent to that at
which the duct and the tubules are formed. These are due
to the invagination of the peritoneal funnel of the tubule
by a vascular ingrowth, which later constitutes the true
glomerulus. The glomeruli and the tubules are bound
together, as it were, by the cells which are the parenchyma
of the Wolffian body. That this tissue bears a superficial
resemblance to gelatinous connective tissue is true, but there
is no evidence that it is mucin-containing tissue.

It is important to show the exact relationship there is
between these several structures — duct, tubules, and

glomeruli—and the various component parts of the testis and epididymis.

The genital ridge, or sexual eminence, as has been mentioned, is an elevation on the mesial side of the Wolffian body, and is seen at an early period of embryonic life. Upon this ridge there are cells, from which the generative elements are subsequently developed. Such cells are spoken of as the germ epithelium. In their earliest stages there is nothing to point to a difference in sex, though in the adult the distinction is so clear and decisive. The precise histology of the cell elements of the genital ridge is of much interest and importance. Here it is, in fact, that succeeding generations have their primary existence, and here it is that want of full development in the individual cells may lead to imperfect formation of the sexual organs, and to much that is unsatisfactory in the after-life of their possessor.

Briefly, when the ridge is minutely examined, there are seen two varieties of cellular elements—one a set of large branched cells, the processes of which join to form a reticulum ; the other, consisting of rather smaller cells, unbranched, and lying in the spaces of the reticulum formed by the fusion of the branches of their companion cells.

The stroma of the genital ridge, where it comes in contact with that of the Wolffian body, is continuous with it, and is almost identical in its ultimate structure.

Here, it will be seen, is a connection with the stroma of the future testis and the original Wolffian body—a matter of some pathological importance.

The lining endothelium of the body-cavity when traced over the genital ridge shows marked changes. Instead of the usual layer of single cubical cells—the peritoneal endothelium—there will be found cells which are varied in their size and in their shape, some being large, others almost insignificant ; some being oval, some cubical, and others even columnar.

In addition to the stroma and germinal cells, the genital eminence from quite an early period possesses bloodvessels.

In time this genital elevation acquires a bulk which is even greater than that of the Wolffian body itself.

In the genital mass of the human embryo, at about the fifth week of intra-uterine life, there can be seen solid columns of cells, which are probably the early stages of the future seminal tubules. These columns of cells may be the first indication of the distinction of sex.

It is here of interest and importance to note that although the Wolffian body, and therefore its tubules, is close to—in fact, in contact with—the genital mass, yet the tubules never penetrate actually into its substance.

Further, there is the formation of the mesorchium, and later of the tubuli seminiferi. The genital mass, originally merely an elevation on the wall of the body-cavity, soon becomes so increased in size that its basal attachment appears somewhat constricted. These alterations are in common with those occurring in the Wolffian body, but at the same time there is a marked differentiation of the latter from the former. Both sexes show these changes alike.

During the period in which this formation of a pedicular attachment is in progress great and distinctive modifications are taking place within the Wolffian body itself, causing it to be so profoundly altered that sex characteristics become abundantly evident.

Transition or Descent of the Testis.

Even before the differentiation of the genital mass into well-defined bodies, known as the testis or the ovary, there begins to be a disposition for a change to occur in the relationship that they bear to the surrounding structures. This transition is towards the tail-end of the embryo. The passage is, therefore, to what in the human subject may be termed the lower part of the abdominal cavity, and then through the abdominal parietes and into the scrotum.

It will be noted that, in the usual position of the fœtus *in utero*, this movement is not, strictly speaking, a descent, but rather an ascent.

There are practically, then, three stages in the transition of the testis — an intra-abdominal, an intraparietal, and a scrotal.

Therefore the human testis may be arrested on its journey

within the abdomen, in the abdominal wall, or in the upper part of the scrotum.

In order to fully understand the conditions which arrest may lead to, it is essential to be familiar with some of the details relating to the normal factors at work in causing the migration of the organ, and those abnormally acting in producing its arrest.

The earliest relationships of the genital mass, as it has been seen, are with the Wolffian body and with the permanent kidney ; but there is present in close proximity to all these structures the primordial foundation of the skeletal elements, and the relative position of the genital mass to these is, perhaps, the surest guide to changes in its site.

In the rabbit's embryo the genital mass on or about the thirteenth day lies further forward than does the true kidney mass, which latter, however, in the next twenty-four hours grows towards the head-end until it lies behind the middle of the Wolffian body, and consequently opposite the genital mass itself. The growth, then, of the Wolffian body tail-wards and of the kidney mass towards the head tends to cause an alteration in the relative position of several structures, and is therefore the real cause of such a change, rather than any actual movement on their part. Further, the formation of the cartilaginous basis of the pelvic bones and the gradual growth of these forwards, so as to bring the rudimentary bones into a position which is nearer the head-end of the embryo, necessitates an appearance of even greater alteration in the site of the genital body. Again, it will be observed that it is no active movement of the genital mass which causes the changed relationship, but rather once more the rapidly extending growth of the surrounding structures.

Originally, the true kidney and the genital mass bear a very close juxtaposition, and it would seem that the marked growth of the lumbar spine tends to cause a visible separation of the two glands. The kidney remains immobile in front of the lumbar spine, while the sexual organ appears to maintain its first relationship to the cartilages of the pelvis, and thus it comes about that the elongation of the lumbar portion of the vertebral column is necessarily one cause of

the separation that is effected between the kidney and the testis.

The latter has by this time assumed a more globular shape, and lies in front of the ilium at the brim of the pelvis, and not far away from the site of the deep abdominal ring through which it has later to pass. Its lower end almost touches the hypogastric artery. The mesorchium is, in addition, more distinct and longer than it was.

The deduction from the foregoing remarks is that so far growth and development have been apparently the only factors at work in bringing about the definite change of relationship of the testis to its immediate surroundings. The change has, in fact, been due to the irregularities in the growth of the different tissues, but it is altogether an uncertain matter as to what produces this unequal growth.

Next comes the passage of the testis along the remainder of the brim of the pelvis, through the abdominal wall, and into the scrotum. This extrusion would seem to be of the nature of an active transition.

Concerned in it are the greater development of the mesorchium, with its ascending portion, the plica vascularis, and its descending part, the plica gubernatrix; the formation of the gubernaculum itself; the fashioning of the inguinal canal, and the processus vaginalis; and, lastly, the appearance of the scrotum proper.

The extent of the development of the mesorchium varies considerably in different human fœtuses. In some it is marked, and the distance from the dorsal attachment to the sexual gland on the ventral aspect is great. In others it is not so readily observed, and it is short, and thereby rather flattened out.

The character of the mesorchium has probably some bearing upon the perfect transit of the testis through the abdominal wall. The dorsal attachment of the mesorchium lies loosely along the front of the psoas magnus muscle, and between its folds of peritoneum are found the testis and its vessels anteriorly and the gubernaculum and the vas deferens posteriorly.

At about the fourth month of intra-uterine life in the

human fœtus the gubernaculum testis begins to be formed. At first it consists of merely the plica gubernatrix, enclosing only connective tissue, but by the later inclusion of fibres of a muscular nature a contractile envelope to the connective tissue is produced.

In the early stages these muscular fibres do not reach the lower end of the testis, but terminate at the site of the crossing of the gubernaculum by the vas deferens. Subsequently, however, they extend upwards as far as, or even further than, the testis proper. It is this higher position that brings them into contact with the cæcum, the vermiform appendix, the lower end of the ileum, and the mesentery on the right side.

The inferior portion of the gubernacular fibres, both muscular and fibrous, but chiefly the fibrous, terminates in the abdominal wall, blending with the external and internal oblique muscles, while others pass to be attached to the front of the pubes and to the root of the penis; while others, again, are found ending in Scarpa's triangle, in the neighbourhood of the saphenous opening, and others pass backwards into the perineum; and, lastly, the remainder, no inconsiderable number, extend to the lowest part of the scrotum, there to form an attachment which as a rule requires actual division in the adult before castration can be completed.

The fibres that enter the abdominal wall in measure finish upon the side of what afterwards becomes the processus vaginalis.

With regard to the structure of the gubernaculum, it has been seen that there are at least two constituents—namely, the fibrous and the muscular. The muscular may possibly be of both unstriped and striped varieties.

The functions of the gubernaculum are by no means clear. That it contains muscular fibres lends colour undoubtedly to the belief that it has some active power in producing a pull upon the testis and the epididymis in the direction of the scrotum, and in some instances in the direction of the other positions into which its fibres pass. Further, it is conceivable that the fibrous tissue that enters into its forma-

PLATE I.
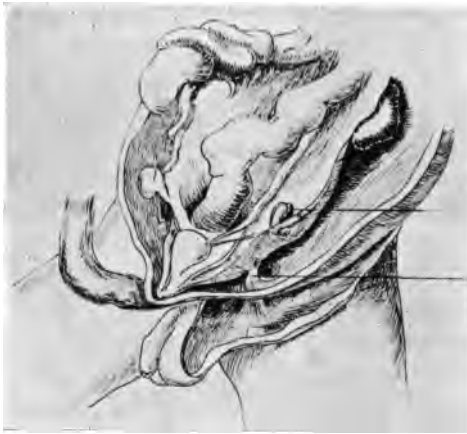
tion may after a time become shortened, and so promote still more a drag upon the testis. It is interesting to note that the lower attachments of the gubernaculum are without doubt in places where the testis arrives either normally or abnormally.

The formation of the pouch of peritoneum, known as the processus vaginalis or funiculo-vaginalis, is peculiar, and yet in keeping with the various dispositions that the parietal peritoneum sees fit to assume. The protrusion is probably a true 'growing out' of the serous membrane, and is not due to either a 'dragging forth' or to a forcible 'pushing out' of the same.

It is important to bear in mind the fact that this pouch of peritoneum precedes the testis into the scrotum, and that it may therefore reach this region even in instances in which the testis still remains a prisoner within the abdomen. It is in the area where the muscular wall of the abdomen appears to be weak—namely, just external to the site of the deep epigastric artery—that the first evidence of the protrusion is to be seen. This is the future deep abdominal ring.

Accompanying the processus vaginalis in its outward growth is a mass of extraperitoneal tissue and fat. This, it will be seen, has an important bearing upon the development of the adipose tissue of the cord. This tissue is, to some extent at least, derived from that which originally lies close to the adrenal—another fact of interest in connection with the histology of certain new-growths in the region of the cord.

The scrotum is formed by the fusion of the two folds of skin of the embryo situated below and to the side of the rudimentary penis, and this junction takes place some considerable time before the transit of the testis has been completed.

Moreover, it is questionable, as will be seen later on, whether the passage of the testis down towards the scrotum, and finally normally into it, has any bearing upon the proper development of the receptacle itself. The scrotum, in fact, may be completely developed, but wholly undistended, by the absence from it of one or both testes.

CHAPTER II.

IMPERFECT TRANSITION OF THE HUMAN TESTIS, WITH ITS EFFECT UPON THE ANATOMY AND PHYSIOLOGY OF THE GLAND.

THE human testis may be arrested at some spot in the normal route along which it migrates—namely, in the abdomen, in the inguinal canal, just below the superficial or external abdominal ring, and in the higher parts of the scrotum. These constitute non-descent, partial descent, or retention.

On the other hand, the human testis, having proceeded as far as the exit of the inguinal canal, may pass into an unnatural position, such as the perineum, the upper part of the thigh, the root of the penis, or towards the anterior superior spine of the ilium on the superficial surface of the aponeurosis of the external oblique muscle of the abdominal wall.

These constitute abnormal descent, or ectopia.

Partial Descent of the Human Testis.

A considerable number of conditions have been described as the causes of the arrest of the human testis, some of which are fanciful; others undoubtedly have an appearance of being actually in operation. It is probable that there are different factors in different cases, and in some instances more than one cause may have been at work.

The several conditions may be classified as follows:

CONDITIONS ASSOCIATED WITH THE MESORCHIUM.

1. The mesorchium may be too long. The testis would under such a circumstance hang too freely within the

PLATE II.

FIG. 2.—ABDOMINAL RETENTION OF THE LEFT TESTIS.
The left half of the scrotum is developed, but is not distended.

PLATE III.

a, Left testis with its tunica vaginalis unopened; *b*, right testis with tunica vaginalis opened.

Fig. 4.—Dissection to show Inguinal Retention of Both Testes. (Godard.)

A, Right testis fixed by its posterior border; B, head of the right epididymis; C, the right processus vaginalis; E, the left testis placed on its side; F, the left epididymis; G, the left processus vaginalis; R, raphé.

abdominal cavity, and thus be prevented from engaging the mouth of the processus vaginalis, or, more correctly, the mouth of the oblique passage along which the pouch of peritoneum has been drawn.

2. Adhesions may have formed between the peritoneum of the mesorchium and the adjacent portion of the serous membrane, and are generally the outcome of intra-uterine fœtal peritonitis.

3. An abnormal persistence of the plica vascularis may unduly tether the testis.

Conditions associated with the Testis and its Component Parts.

1. The spermatic vessels may be too short. This is a condition which is not only of importance in connection with imperfect descent, but also with imperfect development.

2. The vas deferens may be of insufficient length.

3. The testis itself may be of abnormal size as compared with the usual size of the track along which it has to leave the abdomen.

4. The epididymis may itself be of abnormal size compared with the track along which it has to descend.

5. There may be a fusion of the two testes—synorchism.

6. Certain forms of hermaphroditism.

Conditions associated with the Gubernaculum Testis.

1. There may be a deficiency or absence of the lower or scrotal attachments.

2. There may be a deficiency of the activity of its muscular fibres.

3. Possibly even a want of its upper attachments may lead to a fault in descent.

Conditions associated with the Cremaster.

1. A want of action of the internal fibres of the cremaster before the testis has reached the inguinal canal.

2. A retraction by the action of the cremaster of the testis after it has gained its normal position in the scrotum.

Conditions associated with the Route along which the Testis passes.

1. An ill-development of the inguinal canal.
2. An ill-development of the superficial abdominal ring.
3. An ill-development of one half of the scrotum.

Other Conditions not falling under the above headings.

1. Pressure of a truss for an accompanying hernia preventing the onward passage of the testis from the inguinal canal to the scrotum.

In the present state of knowledge, it is difficult to assign the proportionate importance of the various causes which are here tabulated, and it may be that there are others—and these the really potent ones—which have yet to be discovered and described.

The account given, however, will serve to show that the subject of the reason of the imperfect descent of the human testis is a complex one, and probably one that is not by any means fully worked out.

In certain cases, although the body of the testis proper may be retained within the canal, the vas and even the epididymis may descend to a much lower level, and can be felt outside the canal. In connection with this fact it is well to remember that the vessels of the testis are quite distinct from those of the vas and epididymis.

Abnormal Descent of the Human Testis.

There are probably only two causes of the abnormal descent, or ectopia, of the testis. The first is that the testis is drawn into its unusual position by the traction of certain fibres of the gubernaculum testis. The second is that the testis is pushed into its abnormal place by an advancing hernia.

In connection with the former it is necessary to remember that the lower attachments of the gubernaculum are not only into the tissue at the bottom of the scrotum, but that there are also at least three other additional positions in which

PLATE IV.

FIG 5.—RETENTION OF THE RIGHT TESTIS AT THE LOWER PART
OF THE INGUINAL CANAL. (AMMON, 1842.)

The right half of the scrotum is developed, but it has not been distended
by the testis. *a*, Right testis.

FIG. 6.—RETENTION OF LEFT TESTIS IN THE CANAL, WITH
DESCENT OF EPIDIDYMIS INTO THE SCROTUM.

PLATE V.

FIG. 7.—THE LEFT TESTIS, SOMEWHAT SMALLER THAN THE RIGHT,
LYING JUST BELOW THE SUPERFICIAL ABDOMINAL RING.

The left half of the scrotum is developed. (Photo of a lad, aged thirteen.)

PLATE VI.
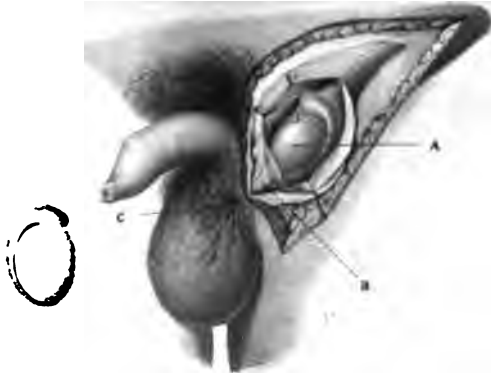
FIG. 8.—A LEFT TESTIS RETAINED IN THE CRURO-SCROTAL FOLD.
(GODARD.)

A, Testis ; B, fasiculus of gubernaculum attached to scrotal tissue at C.

FIG. 9.—A LEFT TESTIS LYING IN THE PERINEUM.   (GODARD.)

The testis was the size of an almond, and its component parts could be
readily made out through the skin.   The left half of the scrotum was
undeveloped.   The right testis was of normal size in the right half of
the scrotum.

they terminate. These attachments may be of a permanent nature, or only transitory in their existence.

The actual regions in whch they have been observed are : the perineum, Scarpa's triangle, about the root of the penis, and towards the anterior superior spine of the ilium.

Those fibres which pass into the perineum may terminate by the side of the anus, may blend with the external sphincter, or may be attached to the ischial ramus. With regard to the fibres which pass into the neighbourhood of the upper part of the thigh, they are fairly constant, but are only to be found at a comparatively early stage of intra-uterine life, disappearing some two months before birth. In spite of this fact, the testis does occasionally pass into the femoral region, and even as late as early adult life. It is not clear, therefore, that the gubernaculum can be always given the credit of drawing the testis into its unwonted position.

It is extremely doubtful whether a testis has ever spontaneously passed into the upper part of the thigh through the femoral ring. The classical cases which are to be found in medical literature, and which are advanced to prove this line of exit, are not altogether convincing as to the exact path along which the testis moved, for some of them are but imperfectly reported. ·Recent dissections during a radical operation upon the accompanying hernia have not shown the cord lying in the femoral ring, but always in the superficial abdominal ring.

That a hernia may in its advance force a testis from its normal course into a position which is quite foreign to it is fairly certain, and most, if not all, of the instances where the testis has been found lying in front of the aponeurosis of the external oblique muscle superficial to the inguinal canal are in reality examples of this pushing, and not of the drawing action exerted by the fibres of the gubernaculum.

Into whatever position the testis unnaturally passes it takes with it a process of peritoneum, forming the processus vaginalis, provided that the pouch remains in communication with the general peritoneal cavity, or the tunica vaginalis if it is shut off from the same.

While thus reviewing the imperfect and the abnormal

descent of the human testis, it is interesting to remember in connection with the pathological conditions which may be associated with the same that what may be imperfect or abnormal in the human subject may be the natural and perfect state in other animals.

Taking only the vertebrata in which the testis has an inclination to descend, it will be found that the organ remains permanently within the abdomen near the kidney in animals of which the snake, the pigeon, and the frog are typical examples. In these, therefore, there is practically no descent whatever.

In the hedgehog, on the other hand, while the testis certainly does continue to reside within the abdomen, yet it lies close to the deep abdominal ring—that is, the entrance to the inguinal canal. Here there has been some considerable descent.

In the hare the organ has left the confines of the abdominal cavity, and is placed in the inguinal canal permanently, a position which indicates a still further descent.

In those animals other than man in which the testis has reached the scrotum it may still retain some indication of imperfection when compared with the human gland. In apes, for instance, it is the rule for the processus vaginalis testis to remain patent throughout life.

In the pig the testis normally passes into the perineum, the scrotum never being distended, while in marsupials the sexual gland occupies a position which is prepenial.

It is also worthy of note that the place of the testis in some animals is not permanently scrotal, but that the organ descends thither only during a period of special sexual activity, being withdrawn into the canal or the abdomen when this time is passed.

Further, in other animals the testis, which is of comparatively small size as a rule, becomes greatly enlarged during the breeding season, returning to its more usual size when this period is over.

The actual size of the testis compared with the weight of the animal to which it belongs varies much in different classes.

PLATE VII.

FIG. 10.—THE LEFT TESTIS IN THE PERINEUM OF AN INFANT.

The left half of the scrotum is developed but not distended. (From a case of Dr. E. W. Sharp.)

FIG. 11.—LEFT TESTIS IN THE PERINEUM.

The accompanying hernia retained by the hand.
(See also Fig. 69.)

PLATE IX.

FIG. 13.—A RIGHT TESTIS IN SCARPA'S TRIANGLE.

The right half of the scrotum is developed but not distended. (From a photograph of a man, aged thirty-five, who said his right testis had always been in this position.)

FIG. 14.—A RIGHT TESTIS AT THE ROOT OF THE PENIS.

The right half of the scrotum is developed but not distended. (A case of Mr. Bilton Pollard's recorded in the *Medical Chronicle*, December, 1895, p. 193.)

In many carnivorous animals—as, for instance, in the cat or the dog—the testes are relatively small. Herbivorous animals, such as the goat and the ram, on the contrary, have comparatively large testes.

In the human subject the testis that has normally reached the lowest part of the scrotum is in the great majority of instances fully developed; but if the organ should be arrested, then there is a general probability of imperfect development. On the other hand, in those animals in which the testis lingers on its descent, or does not even start to descend, the development of the organ will in no way suffer. There is, therefore, some subtle influence at work in the testis of the higher vertebrates which renders a full descent necessary, as a rule, for perfect development. It is also a fact that the various pathological conditions associated with imperfect descent in the human subject are unknown, or almost unknown, in those testes of animals whose glands for some reason never transgress the limits of the abdominal wall.

Effect of Imperfect Descent of the Testis upon the Anatomy of the Gland.

The effect of imperfect descent upon the testis itself, in so far as its anatomical characters are concerned, lies chiefly in the fact that the organ is usually smaller than its normally placed fellow, or, at any rate, smaller than a testis should be in an individual of the same age with the testis in its proper position. While this is true in most instances, it must be noted that this want of growth is not invariable, for in about one in twenty-four cases the arrested testis is of normal size; but even this magnitude does not necessarily imply normal development. The cause of this diminution in the size of the arrested testis is not by any means yet a settled point. The condition may be reviewed in at least three ways.

The first is that there has been an initial want of perfect formation of the organ, altogether apart from the want of complete descent.

The second is that the organ advances in its usual growth up to the period of the beginning of sexual life, but never

undergoes that full development which should coincide with the onset of puberty.

The third is that the testis does acquire its normal size, together with its complete physiological activity at puberty, but that owing to its abnormal position it is soon involved in retrogressive changes, producing in the end entire atrophy of the seminal tubules and a consequent loss of function.

It must be confessed that there is still a want of clear evidence in favour of any one of these three suggestions being alone answerable for the condition of the organ, and it is possible, even probable, that each should have its quota of cases placed under its respective heading.

The testis, as it lies within the abdomen close by the kidney, or in the iliac fossa, or just internal to the deep ring, or when it has passed into the inguinal canal, or, further, when it has reached so far as the exit of the canal or the upper part of the scrotum, is commonly softer and less resistant than is the normal gland. Of recent years a considerable amount of attention has been directed to the want of development of the imperfectly descended testis, chiefly from the fact that there has been much difference of opinion as to the proper manner in which to deal with it when met with in the course of a radical operation upon an associated hernia.

Minute Structure of an Imperfectly Descended Testis.

It may be well before proceeding to the description of the minute anatomy of the imperfectly descended gland to briefly review that of the fully developed organ. An active adult human testis may be described as having well-formed seminal tubules, held together by a minimum amount of interstitial connective tissue. These tubules show spermatogenesis in all its stages. The walls of the tubules are composed of several layers of flattened cells, well formed and regularly arranged. The tubules themselves are lined by epithelial elements grouped as irregular strata. These may be said to form three fairly distinct layers.

The outermost or lining layer is made up of cubical or slightly flattened cells, often termed the cells of Sertoli,

PLATE X.

FIG. 15.—SECTION OF A SCROTAL TESTIS FROM A FULL-TERM FŒTUS.
Tubules are numerous, but interstitial tissue is abundant.   (× 25.)
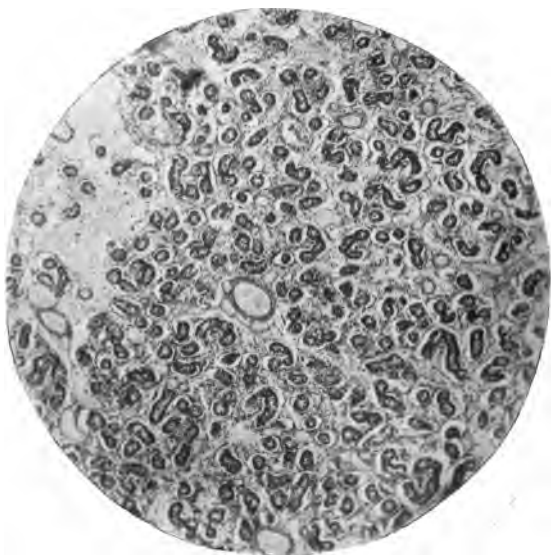
FIG. 16.—SECTION OF THE SCROTAL TESTIS OF A NEW-BORN CHILD.
Shows the numerous immature tubules, with a considerable amount
of intertubular connective tissue.   (× 50.)

PLATE XI.

FIG. 17.—SECTION OF A NORMAL SCROTAL TESTIS FROM A BOY, AGED FIVE.

Shows many tubules, but still a considerable amount of interstitial tissue. (× 40.)
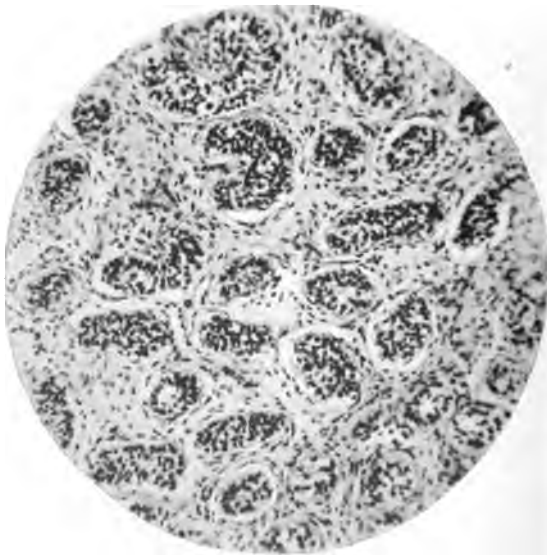
FIG. 18.—SECTION OF A NORMAL SCROTAL TESTIS FROM A BOY, AGED FIVE.

Shows well-developed and numerous tubules, but also a considerable amount of interstitial tissue. (× 60.)

PLATE XII.
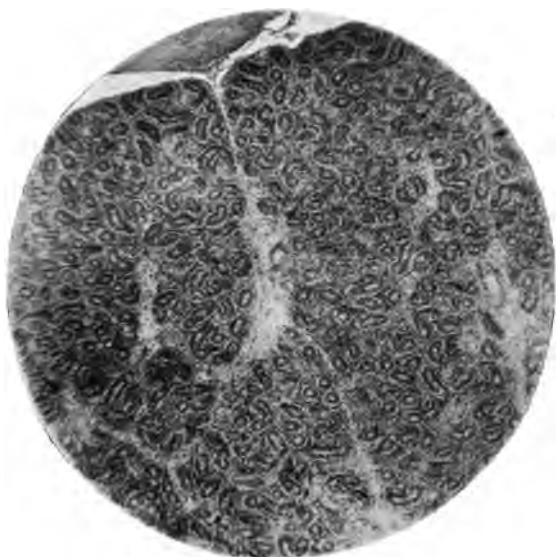
FIG. 19.—SECTION OF A NORMAL SCROTAL TESTIS FROM A BOY, AGED EIGHT.

Shows numerous tubules and diminishing amount of interstitial tissue. (× 40.)

FIG. 20.—SECTION OF A FULLY DESCENDED TESTIS OF A BOY, AGED SIXTEEN.

Shows well-developed maturing tubules, and but little intertubular connective tissue. (× 150.)

PLATE XIII.
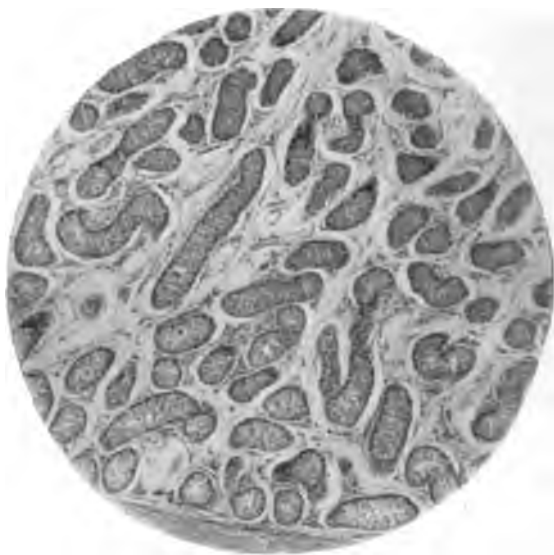
FIG. 21.—SECTION OF FULLY DESCENDED NORMAL TESTIS OF AN ADULT.

Shows active tubules.   (× 50.)
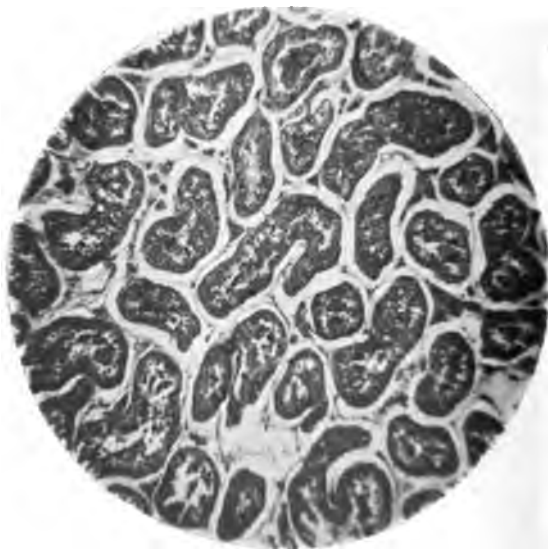
FIG. 22.—SECTION OF A NORMAL SCROTAL TESTIS FROM A MAN, AGED THIRTY-TWO.

Shows fully developed and active tubules, with but little interstitial tissue.   (× 80.)

PLATE XIV.
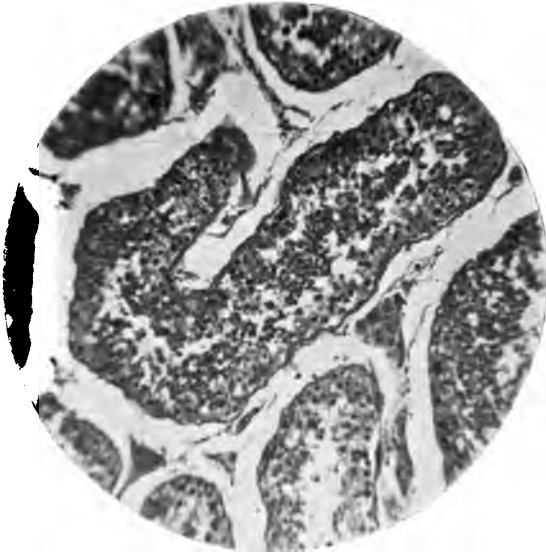
FIG. 23.—SECTION OF THE SAME TESTIS AS IN FIG. 22.

Shows spermatogenesis in fully developed tubule.   (× 150.)

FIG. 24.—SECTION OF A FULLY DESCENDED TESTIS FROM A MAN,
AGED SEVENTY-FOUR.

Shows atrophy of tubules and great increase of intertubular
connective tissue.   (× 150.)

PLATE XV.
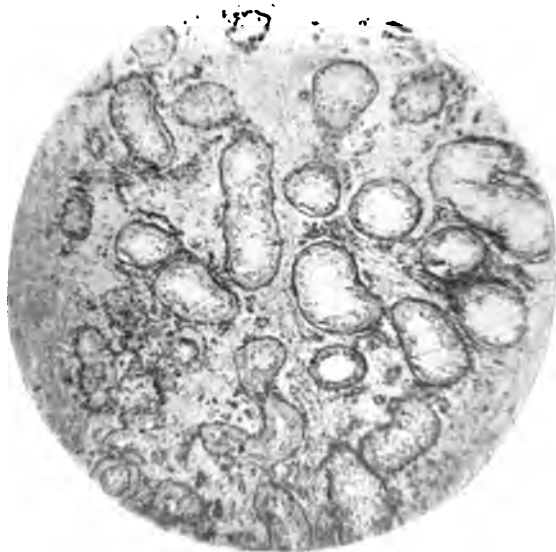
FIG. 25.—SECTION OF A TESTIS REMOVED FROM THE INGUINAL CANAL.

Shows but few and poorly-developed tubules, and many interstitial cells in the intertubular connective tissue. (× 50.)
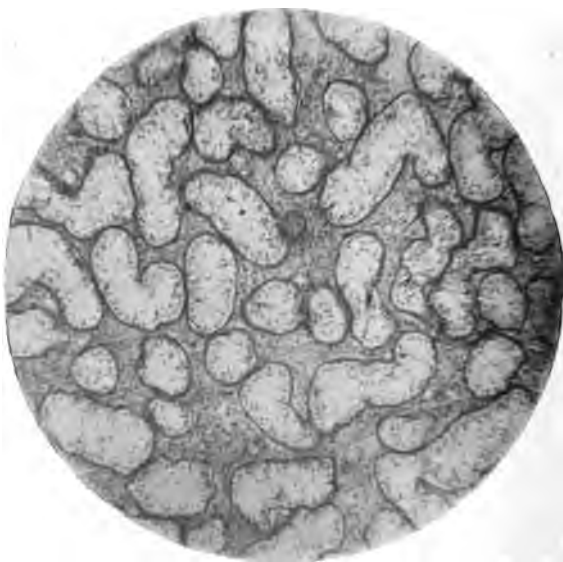
FIG. 26.—SECTION OF A TESTIS REMOVED FROM THE INGUINAL CANAL OF AN ADULT.

Shows tubules fairly well developed but inactive. (× 50.)

PLATE XVI.
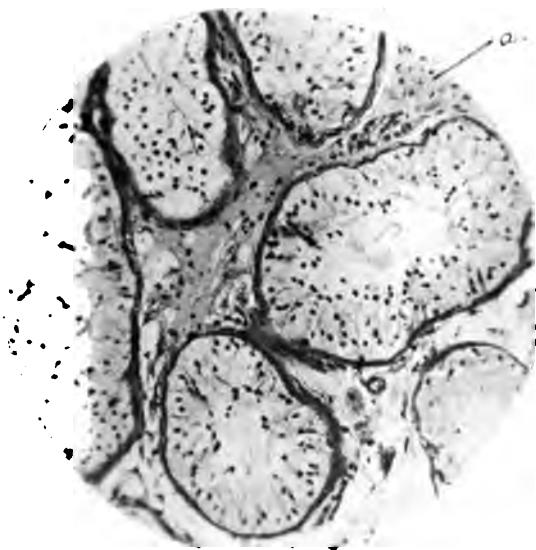
FIG. 27.—SECTION OF A RIGHT TESTIS REMOVED FROM THE
ABDOMEN OF AN ADULT.

Shows well-formed tubules and many interstitial cells—*a*. (× 150.)
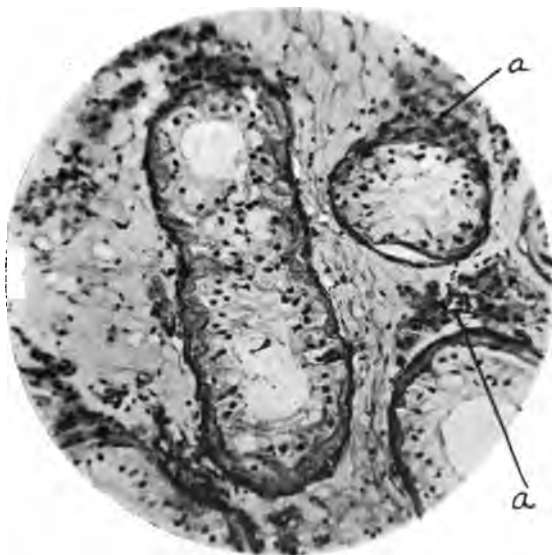
FIG. 28.—SECTION OF A TESTIS REMOVED FROM THE INGUINAL
CANAL OF AN ADULT.

Shows numerous interstitial cells—*a, a*. (× 150.)

PLATE XIX.
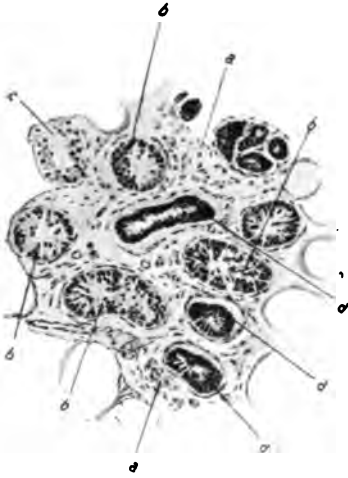
FIG. 34.—TUBULES AND INTER-
STITIAL CELLS.

a, Interstitial cells; *b, c,* active
tubules; *d,* infantile tubules.
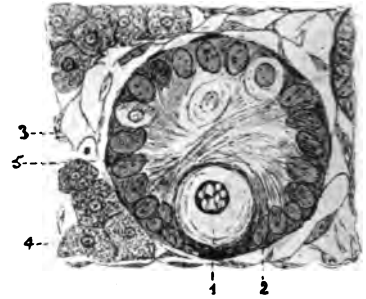
FIG. 36.—DIAGRAMMATIC SECTION
OF A FŒTAL TESTIS OF A FOAL.

1, Sperm cell; 2, germinating cells;
3, connective tissue; 4, inter-
stitial cells; 5, fibrillary matrix.
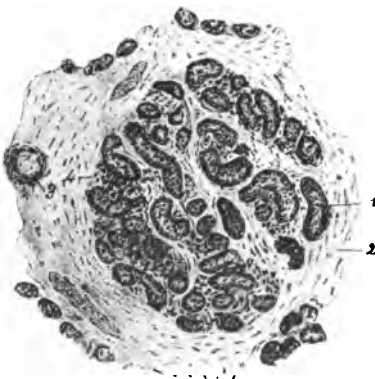
FIG. 35.—SECTION OF A TESTIS REMOVED
FROM THE ABDOMEN OF A HORSE,
AGED THREE YEARS.

1, Seminiferous tubule; 2, fibrous septa;
3, artery; 4, group of interstitial cells.
(× 40.)
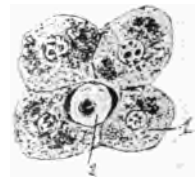
FIG. 37. — GROUP OF FOUR
INTERSTITIAL CELLS
AROUND A CAPILLARY,
FROM THE TESTIS OF A
FOAL.

1, Interstitial cell; 2, capillary
containing a white cor-
puscle. (× 1000.)

which lie immediately within the basement membrane of the wall of the tubule. Some of these may here and there show some evidence of proliferation. The next layer con-sists of large rounded cells with clear protoplasm, and they are irregularly placed. These are the cells that are chiefly concerned, it is probable, in the formation of spermatozoa. They may be termed the intermediate, the proliferating, or spermatogenetic cells. The innermost layer is one of granular, ill-defined cells, which appear so closely associated as to produce an almost uniform mass, staining badly, and show-ing no tendency whatever to division. Their nuclei are small, and towards the lumen of the tubule they become very faintly outlined. This mass of cells may be looked upon as the nutritive layer. Embedded in the inner part of this stratum are the heads of the spermatozoa, and it is probable that these become freed by the liquefaction of the protoplasmic layer in which their heads lie concealed.

When, on the other hand, the structure of the tubules of a testis that has failed to reach its proper level is examined, there will be found a very different histological picture. The seminiferous tubules, or what should be seminiferous, are smaller, more widely separated from one another by the interstitial tissue, and are fewer in number and probably shorter in length than those of the normal organ.

Between the tubules themselves there is much loose con-nective tissue, which is rich in bloodvessels, in spite of the otherwise ill-development of the gland. Scattered through-out this tissue there are nuclei, belonging almost certainly to peculiar interstitial stroma cells. In some sections these appear to have undergone considerable development both in number and size.

Such interstitial cells are also at times present in the normal organ, but may be found sometimes in the fœtus or the young infant, and are also often seen when the gland is about to undergo its further development, at or just before the onset of puberty. What their function and significance may be is still problematical. Possibly they are associated with an internal secretion of the organ, a secretion which may be needful for the full development of the male charac-

teristics, and the fact that they are present so uniformly and in proportionately such large numbers in the imperfectly descended testis may point to the fact that they are peculiarly necessary for this purpose in the absence of spermatozoa-producing tubule cells. The connective tissue here and there also presents lymph spaces. The basement membrane of the abortive tubules is well developed, but the lumen of the same is filled with a mass of granular débris, containing a large number of nuclei of various shapes and sizes, these being probably derived from the cells lining the tubule. Neither spermatoblasts nor spermatozoa can be demonstrated in the tubules of by far the larger number of imperfectly descended testes.

Physiology of the Imperfectly Descended Testis.

Nearly all authorities are agreed that the testis which has failed to reach its normal position in the scrotum is function-less so far as the formation of spermatozoa is concerned. While there is no doubt that this statement is true of the vast majority of instances in which the testis is arrested in the usual line along which it descends, whether in the abdomen, in the inguinal canal, or just below the superficial abdominal ring, yet even in any one of these positions it may be fully developed and capable of producing sper-matozoa. This fact has been indubitably proved by the microscopic examination of the semen ejaculated, and of the lining membrane of the tubules of the gland itself, in addition to the evidence afforded of the procreation of children.

Further, if the testis has passed into the perineum, it is not by any means always non-developed or atrophic in character. When lying in front of the aponeurosis of the external oblique muscle of the abdomen, in Scarpa's triangle, or at the root of the penis, it is seldom that the organ is capable of its generative function. Thus it will be seen that double arrest, or ectopia with associated want of development, as a rule, means absolute sterility on the part of the individual, although he may at the same time be perfectly virile. It may be, therefore, that while the spermatozoa-producing

function of the gland is in abeyance, yet the formation of an internal secretion has enabled the possessor to gain the manly characters, while, should no internal secretion be formed, possibly owing to the absence of the interstitial cells, he will for ever remain in a puerile condition.

There is also some real doubt as to whether a testis arrested from birth, but brought down in early life into the scrotum, will thereby develop and become the seat of sper- matogenesis. Though there are a certain number of cases on record where this has been stated to have occurred, it must be confessed that they are few and far between, and some of them rest on but scanty evidence. Moreover, testes which at birth are lying in the inguinal canal, or even in the abdomen, have been known to gradually descend, or even do so hastily, either before or after the onset of puberty. It may thus be that some of the glands which have been brought down and placed in the scrotum were those which had merely had their passage delayed, and would eventually have reached their proper habitat by natural means and become fully capable of function.

CHAPTER III.

INFLAMMATION OF THE IMPERFECTLY DESCENDED TESTIS.

THE testicle which has not reached the lowest limit of the scrotum, or which has passed into abnormal positions, is liable to inflammation, arising from the same causes as the inflammatory conditions of the fully descended organ.

But, in addition, the site of the testis, when arrested or when ectopic, renders it prone to become inflamed from reasons other than those operating upon the normally situated gland.

Inflammation of the imperfectly descended testis may be due to :

1. Traumatism. ·
2. Extension of inflammation from the urethra.
3. Secondary inflammation in parotitis.

In all three of these the inflammation will be of an acute nature.

4. Deposit of tubercle bacilli.
5. Syphilitic infection.

In each of these the inflammation will be of a chronic character.

Traumatic Inflammation.

Causation.—It is inflammation due to traumatism which is so peculiarly the misfortune of the testis which is abnormally placed. A testis hanging from a normal cord in the lowest part of the scrotum, although apparently so exposed to damage, is in reality well able to get out of harm's way. It is so mobile that it slips aside almost at

the approach of violence. Not so the testis which hangs high in the scrotum or just below the superficial abdominal ring, often tethered by a short, altogether unyielding cord, or the gland which is retained in the inguinal canal. The two former positions cause the organ to be exposed to receive blows and various forms of pressure which it is unable to avoid. Many a time the testicular tissue is pressed backwards against the resisting body of the os pubis. Such an injury is certain to result in a sharp attack of orchitis. It is here also, outside the inguinal canal, that the imperfectly descended testis is liable to be injured by the improper application of a truss or the adjustment of an unsuitable instrument.

As should be continually remembered, alike by the patient and the surgeon, the pad of an inguinal truss to be employed in the case of a hernia associated with a testis lying just below the superficial ring must never be placed upon the bone, but must ever rest on the soft tissues overlying the inguinal canal. In like manner, the adjustment of the so-called horse-shoe or forked pad truss is very likely to cause injury to, and set up inflammation in, a testis lying high in the scrotum or just below the superficial ring.

When the organ lies in the inguinal canal—that is, in the abdominal wall—it is subjected to pressure from many causes, particularly that of excessive muscular action. It is here also that it may again be irritated by the application of an improper truss, usually one with too strong a spring or one the spring of which has a too marked antero-posterior curve. On the other hand, it is seldom that the properly formed truss, with the pad applied even directly over the testis in the inguinal canal, produces any damage to the organ, which either remains quietly and comfortably behind the pad or slips out of the way of the pressure of the instrument, back into the abdominal cavity, or one side or other of the pad.

If the testis is situated in the canal, but rather at its lower part, just within the superficial ring, and if the cord is not too short, so that the gland has a certain, though limited, range of movement in an up-and-down direction, then a

sudden muscular effort may lead to the extrusion of the organ through the superficial ring, the pillars of which during the passage become separated from one another, to approximate after the descent and bring about pressure upon the cord. Such an accident is generally followed by acute inflammation, with very severe pain.

Torsion of the cord of an imperfectly descended testis, a condition in itself not infrequently due to traumatism of the nature of muscular effort, is another cause of inflammation of the testis.

When the testis has passed into the perineum it is peculiarly prone to become squeezed and bruised from pressure in sitting, horse exercise, or bicycle riding. The testis in Scarpa's triangle is again somewhat exposed to injury, though probably in not so pronounced a degree as in perineal ectopia.

The testis that has not left the confines of the abdominal cavity is not more threatened with injury than is the normally placed ovary. Inflammation of the imperfectly descended testis may occur at any age, but is most common in young adults.

Signs and Symptoms.—The signs and symptoms are very similar to those of the normally placed organ. In acute inflammation, however, the swelling occasioned is hardly ever so great, while the pain induced is often considerably more severe, probably on account of the pressure of the inflammatory products upon the tissues of an already hypersensitive organ. Sometimes the suffering may be so intense as to give rise to some degree of collapse, associated with vomiting. The pain may be referred to the lumbar region. In addition, there is not infrequently some concomitant constipation, together with nausea or actual emesis. The tongue may become coated and the patient appear seriously ill.

If any swelling has been previously noticed at the site of the testis this will be found to be larger in size than before, and often said to have become so suddenly. Fluid, giving rise to tenseness, if not to fluctuation, will be present in the tunica vaginalis, unless this has too free an opening into the general cavity of the peritoneum. The fluid is at first only

serous in nature, but later becomes somewhat turbid and flaky from admixture of inflammatory products, and in other instances it may be blood-stained or consist of almost pure blood.

Sometimes, in those cases in which the tunica vaginalis has descended beyond the arrested testis into the scrotum, the fluid may fill the lower portion of the sac, thus to a certain degree making up for the absence of the testis from the corresponding half of the scrotum.

The skin covering the swelling may be normal in appearance or it may be reddened with increased heat over it. Œdema may be observed on pressure, and the local tenderness may be very great. Occasionally the sufferer complains of some sympathetic pain in the opposite normally placed organ. In a few instances inflammation of the arrested testis has been associated with retention or even suppression of urine.

Neuralgia of the gland may be the outcome of an attack of inflammation.

Diagnosis.—Inflammation when occurring in an arrested testis is liable to be mistaken · for several other conditions, but notably for strangulated hernia. It is because of the similarity of these two lesions that inflammation of the imperfectly descended organ is of such importance.

Diagnosis from Strangulated Hernia.—The orchitis may be mistaken for nipped gut, and may lead to prompt exploration of the swelling, a procedure which, while perhaps not greatly benefiting the patient, will certainly do him no harm. On the other hand, a strangulated hernia may indeed be in existence, and the condition be put down to the effects of an inflamed testis. Such an error is likely to lead to serious consequences. The principal points in the differential diagnosis are as follows: In inflammation the onset is usually gradual, while in strangulation it is generally sudden. In inflammation the symptoms are not so urgent nor so persistent, but in strangulation they are peculiarly acute and continuous until relief is given.

Although the inflammatory affection may produce some of the symptoms present in intestinal obstruction, such as

nausea, vomiting, and associated constipation, together with shock, which if present in the earlier stages tends rather to diminish than increase, yet in strangulation obstruction is really in existence, and therefore copious, persistent, and even stercoraceous vomiting is induced, and the constipation is absolute, while the shock is usually more marked, and deepens rather than lessens. In orchitis, if there is a co-existent reducible hernia, there will be an expansile impulse on the patient coughing, while if the hernia is the seat of strangulation the impulse obtained will be only of a forward nature.

In both conditions fluid is, as a rule, poured out into the cavity of the tunica vaginalis testis, and therefore both swellings are likely to be dull on percussion and tense on palpation.

The local pain in acute inflammation is frequently more pronounced and the local tenderness greater than the same symptoms are in strangulation, and both tend to remain in a severe degree for a longer period in the former than in the latter. But when all the signs and symptoms have been carefully reviewed there may still exist some doubt in the mind of the surgeon as to the precise condition that is present. It is this uncertainty that so urgently calls for an exploratory incision.

Diagnosis from Acute Lymphadenitis.—The inflamed inguinal testis forms a tumour which, from its position, its tenderness, the fact that there may be some amount of œdema of the tissues over it, and even some redness of the skin, may make it liable to be mistaken for acute inflammation of the inguinal lymphatic glands. It must, moreover, be remembered that both of these conditions may be present at one and the same time, on the same side, and also that inflamed glands may be on one side and an inflamed testis on the other.

A careful examination, however, of the case should not leave much uncertainty as to the exact lesion present. It will show that the testis is missing from one side of the scrotum, that the swelling appears to be more deeply seated than a bubo, and that a cause for lymphadenitis is wanting.

PLATE XX.
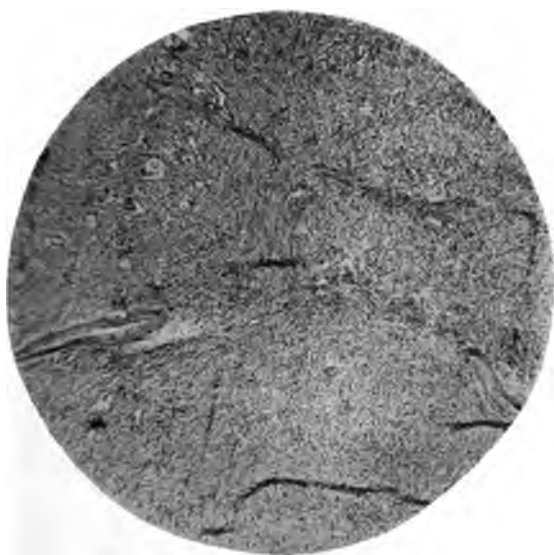
FIG. 38.—SECTION OF A TESTIS FROM THE INGUINAL CANAL, WHICH HAD BEEN SUBJECTED TO REPEATED ATTACKS OF INFLAMMATION, RESULTING IN FIBROID DEGENERATION. (× 50.)

When the two conditions coexist, as may be the case in a patient suffering from gonorrhœal urethritis, the cocci having passed to both the epididymis and the lymphatic glands, the adenitis will overlie the epididymitis, the one obscuring the other. In such a case it is well to invaginate the scrotum, or what there is developed of it on the affected side, and thus to explore, if possible, the interior of the inguinal canal, so as to determine the presence or not of the inflamed testis within it. Even with this proceeding, it may be impossible to arrive at an accurate diagnosis, and an exploratory incision is advisable.

Prognosis.—The prognosis of traumatic inflammation of the imperfectly descended testis is grave so far as the organ itself is concerned. Such an inflammation is nearly always followed by complete atrophy of the gland, or should this not occur after the first attack, a second will nearly invariably succeed, and will finish the disorganization of the testicular tissue. The repeated attacks of inflammation may render the organ the source of great annoyance to the possessor, and even of danger to him.

It is rare for acute orchitis of the arrested gland to end in suppuration. The hydrocele that is often formed in the course of the inflammation may persist after all symptoms of inflammation have subsided.

A testis which has once been the site of inflammation may remain much more sensitive than before, and in certain instances a severe form of neuralgia may distress the patient for a considerable period of time.

Adhesions of the testis to the inner surface of the wall of the tunica vaginalis may be produced, which will usually result in greater fixity of the organ than it had previously possessed.

Atrophy of the already imperfectly developed testis may undoubtedly follow upon one or more attacks of inflammation. Whether, however, malignant disease in the form of sarcoma or carcinoma ever owes its origin directly to traumatic inflammation as an exciting cause is unknown, though the suspicion is strong in some instances. The embryonic elements that may be present in the gland may

be so irritated by the inflammatory processes as to take on malignant activity. In a few cases in which the testis has been situated in the inguinal canal, and has become inflamed, peritonitis has been set up, owing to the fact of there being a persistent communication with the general cavity of the serous membrane.

Treatment.—The treatment of traumatic inflammation of an imperfectly descended testis is either palliative or operative.

1. *Palliative Treatment.*—Particularly in first attacks, provided that the diagnosis is clear, palliative treatment may be conveniently adopted, especially as the removal of a testis, even though it be one that has not reached its normal position, is not looked upon with too much favour by an adult patient or the parents of a minor.

Rest in bed is usually advisable. The application of hot fomentations or of ice, and the exhibition of anodynes, both local and general, may be needed to relieve the acute suffering with which the patient is afflicted. Leeches applied over the swelling in the groin often give great comfort. A saline aperient should be administered. In many instances in which there is much effusion of fluid into the tunica vaginalis aseptic tapping is indicated, and will diminish the tension of, and therefore the pain in, the tumour.

After the acute symptoms have passed off, means should be adopted, if possible, to limit the likelihood of a repetition of an attack, especially the avoidance of the apparent cause of the primary seizure. In those instances in which a hydrocele persists when all inflammatory signs have disappeared, it may become necessary to tap the distended tunica vaginalis, or, further, to dissect it out, at the same time removing or transplanting the testicle.

For neuralgia continuing after an attack nothing is better than the application of flying blisters, should it be deemed advisable to allow the organ to remain.

The peritonitis that occasionally complicates inflammation of the inguinal testis is rarely so severe as to call for more than the relief of the symptoms produced by it. That which may accompany an abdominal orchitis may be much more

serious, and may require strong narcotics to relieve the pain induced.

2. *Operative Treatment.*—During an acute attack it is seldom that an operation is deliberately undertaken for an inflamed testis abnormally situated, but such an organ may be exposed by an incision made in a case of doubtful diagnosis.

The question then arises as to what should be done with the gland—whether it ought to be removed or transplanted into the scrotum. The same matter has to be decided when operative measures are undertaken in the intervals of inflammatory attacks.

It is probable that the better line of treatment is to perform castration, for by this means alone is all danger of a recurrence of the discomfort removed.

Excision of the organ is clearly indicated in those instances where it is very imperfectly developed, particularly in the adult, where it cannot be readily drawn down into the scrotum, where the corresponding side of the scrotum is so small as to be practically incapable of containing the testis if this were placed in it, and if a hernia coexists.

Transplantation, on the other hand, should be attempted where the opposite gland is also imperfectly developed, where the exposed organ is of fair size, where the inflammatory attack is the primary one, where no other disease of the gland exists, and where it can be fairly readily brought down into its new bed.

Excision of an Imperfectly Descended Testis.—Removal of the testis, or castration, is performed somewhat differently, according to the position in which the arrested testis is found.

Castration in Inguinal Inclusion.

Rigid asepsis is imperative. Probably there are few portions of the body that are more difficult to sterilize than the inguino-scrotal region. Not only is this area one in which adventitious matter is liable to collect and to remain clinging to the hairs and the surface of the skin, but in it there are very numerous large and deeply-situated glands,

the ducts and acini of which form secure hiding-places for septic organisms.

The incision to be made when the gland lies in the inguinal canal is similar to that which is used for a radical operation upon an incomplete inguinal hernia, and is, therefore, parallel with the inner half of Poupart's ligament, and about one finger's-breadth above it.

In those somewhat rare instances in which the testis is lying superficial to the aponeurosis of the external oblique muscle the organ will be exposed as soon as the skin and subcutaneous tissues are divided, and can be dealt with as described below.

On the other hand, when it lies actually within the canal, as is usual, it is necessary to separate the fibres of the aponeurosis in a line downwards and inwards, but it is not generally requisite to open up the superficial ring itself. When the canal has been laid bare, the testis will be seen covered by the cremaster muscle, together with its fascia, and with the infundibuliform fascia, both superficial to the tunica vaginalis. When these layers have been dissected off, the surface of the tunica will be exposed. It is well to remember that this cavity may contain fluid, and, further, that it may have a direct communication with that of the peritoneum. It is desirable to always open this sac, because of the possible, and even probable, coexistence of a hernia.

The tunica, with the testis, is now loosened from its attachments to the surrounding tissues, and, being held up by an assistant, the cord is transfixed by a needle carrying silk of a suitable gauge, and ligatured in the usual manner. Care must be taken to secure it very thoroughly, and to place a pair of pressure forceps upon it before it is severed, so that a hold may be maintained on it. By this means it can be readily drawn upon again, should it become evident that the first ligature is not satisfactory. The stump of the cord, after it has been cut through and does not show any tendency to bleed, is allowed to pass out of the grasp of the forceps and to slip into the extraperitoneal tissue.

It only now remains to suture the cut edges of the

aponeurosis, either by several interrupted sutures of fine silk or a continuous one of the same material, and to bring the margins of the skin incision into accurate apposition by interrupted stitches of silkworm-gut.

The most efficient dressing, no drainage being required, is that composed of a few layers of double cyanide gauze, kept in place by the application of a thick layer of collodion. Over this may be adjusted more gauze and a layer of wool, and finally a spica bandage.

If the operation has been carried out with strict asepsis, the patient will make a rapid recovery, and experience no discomfort during the convalescence. The dressings may be left undisturbed until the eighth or tenth day, when they are to be removed and the superficial sutures cut out, and the patient then allowed to recline on a couch.

In a certain somewhat small proportion of cases in which there has been a thinning, and therefore a weakening, of the abdominal wall in the inguinal region by the stretching of the tissues by a large collection of fluid it will be well to advise the use of an inguinal truss for a few months after the operation. Further, such a patient should be instructed to indulge in properly performed systematic exercises with a view to the strengthening of the abdominal muscles.

Castration in Perineal Ectopia.

In this region, again, the utmost attention must be paid to the question of asepsis. The area is one that is easily fouled, and that particularly in a child. There is not infrequently a direct communication with the general cavity of the peritoneum, and therein lies the danger of septic infection being carried upwards and causing infective peritonitis.

The patient at the time of the operation may be either placed in the lithotomy position or left in the dorsal posture. If in the former, the legs should be well separated and securely held by assistants or fastened by the crutch. An incision is then made, not immediately over the swelling,

but as far as possible away from it in the neighbourhood of the superficial ring, so that it may be out of the area of likely infection from the anus and urethra.

The cord, having been isolated, is to be gently pulled upon, so as to bring the testis up into the region of the wound.

There may be a band of tissue — the remains of the gubernaculum testis, which had drawn the organ into its abnormal position—and this may require division before the gland can be fully brought out of the incision. The spermatic cord is then ligatured just below the superficial ring in the manner above indicated, and the stump is allowed to retract into the inguinal canal. The incision is then closed and a collodion dressing applied. A rapid recovery is the rule.

Castration for a Testis placed in Scarpa's Triangle.

When the testis passes into the upper part of the thigh it is probable that it always emerges from the superficial abdominal ring, and then, turning outwards, is drawn or pushed into the region of Scarpa's triangle. In most of the instances of the so-called ectopia cruralis a definite cord can be felt running from the testis up to and through the superficial ring. This is the true spermatic cord.

In order to remove a testis so placed, it is necessary to make an incision parallel with and below the inner half of Poupart's ligament. On division of the subcutaneous tissues the testis is, as a rule, at once exposed. A little dissection will free it from the bed in which it and its tunica vaginalis are lying. Then the spermatic cord is to be secured as near the superficial ring as possible, with the same precautions as have already been indicated. Closure of the wound after section of the cord and the removal of the testis will complete the operation.

Transplantation of an Imperfectly Descended Testis. — The operation of loosening an abnormally descended testis and of transplanting it from the position in which it was resting into the scrotum is called orchidopexy. In the case of the arrested or misplaced testis which has been the seat

of acute inflammation, it is decidedly doubtful whether there is much, if any, advantage to be gained in the attempt to bring the organ down into the proper habitat for the testis, because of the great tendency for the gland which has been inflamed to undergo a complete atrophy after the attack has passed off, and therefore to become useless.

On the other hand, the presence of the testis, even although it should be a very diminutive one, in the place where such an organ should be, is of some considerable amount of satisfaction to an adult patient, and the fact that it had been removed rather than transplanted in infancy might lead to many regrets on the part of the individual when he has reached a full age. It may therefore be advisable to recommend after a primary attack of inflammation that a trial should be made to bring the testis into the scrotum, provided that it has any reasonable chance of success.

It has further to be remembered that an imperfectly descended testis may have a function other than that of producing spermatozoa, and may, by an internal secretion, become capable of materially adding to the well-being of the possessor.

Transplantation of an Inguinal Testis.

There are two methods by which a testis may be brought down into the scrotum, the one manipulation and the other operation.

Transplantation by Manipulation. — This method has but little to recommend it. It is uncertain, rather likely to cause inflammation if it is at all roughly carried out, and of only moderate success in a small proportion of cases.

It consists in easy and careful massage with the finger-tips upon the testis in the inguinal canal from quite the early days of infancy. It is doubtful whether it ever leads to a greater descent than to induce the testis to come to lie just below the superficial ring, a position which may be even a worse one than that within the canal.

It is possible, however, in a certain number of cases that manipulation might be employed with advantage as a pre-

liminary measure before having recourse to orchidopexy. In those instances in which a definite hernia is present this method has nothing to recommend it, and the case should be submitted to operation.

Transplantation by Operation.—A question which at once presents itself when the surgeon examines a patient with a testis in the inguinal canal is, Will this organ be benefited if an attempt is made to bring it into the lower parts of the scrotum ?   If the patient has not reached the period of puberty the answer is that there is a possibility, and only a possibility, that the transplantation will cause the testis to grow, develop, and become a useful organ.   If the patient, on the other hand, has passed this period, or if the testis has been subjected to the baneful influences of only even one attack of inflammation, the answer can only be that there is but the remotest chance of the operation being of the slightest benefit to the sufferer, save that it may place the testis in a position which the possessor considers it should lie, and one in which the subsequent history of the organ can be more effectually studied.

Transplantation may be looked upon as beneficial in that it may be a prophylactic measure, inflammation being thereby in a certain proportion of cases warded off, because the organ comes to reside in a scrotal bed rather than remaining in the muscular plane.   If a child is seen with inguinal inclusion, which has not responded to manipulation in early infancy, but in which the gland is of fair size, or nearly equal to its normally situated fellow, and if it appears to be comparatively freely movable and has not been inflamed, the parents should be advised that an operation may ameliorate the condition, and cannot produce any harm or place the testis in any position worse than it is.

If a hernia complicates the imperfect descent, then the case is one where an operation is still more urgently called for, and transplantation may be the correct method of dealing with the organ.

An attempt to transplant having been decided upon, the right age at which it should be done is a matter of great importance.   There is obviously no use in waiting for the

onset of puberty or delaying until this time has passed, for all the while the testis is open to the risk of becoming inflamed. It is true that a certain number of testes may even descend into the scrotum so late as twelve to sixteen years of age, but generally when they arrive there their size is small and their structure very imperfect. On the other hand, the operation is not advisable at a very young age, and this for several reasons. First, the tissues of the infant are not so suitable for the manipulations required and their holding-power is but feeble; secondly, there is a serious risk of sepsis, and such an untoward circumstance might result in a complete failure in the success of the operation, or even put the life of the child in danger; thirdly, there is a possibility of further descent in the first few years of life.

The period, then, that should be chosen is one between the limits of early infancy and puberty. Probably the best age at which to operate is about six to eight years.

No attempt should be made to transplant a testis while any evidence of inflammation is still in existence. All signs of orchitis should have disappeared, and the surrounding tissues should be normal.

Finally, there still needs to be shown that there is uniform or even a usual beneficial result from the transplantation of the inguinal testis, such as should be declared by the gland proceeding to develop in the same proportion and to the same extent as its normally placed fellow, and by its becoming in after-life a true spermatozoa-producing organ.

Orchidopexy in the Case of an Inguinal Testis.

The preparation of the patient for this operation must be just as thorough in all points as that for the removal of the organ, because the ultimate success of the procedure depends to a very great extent upon the perfection of the asepsis obtained and maintained.

When the testis is lying altogether within the inguinal canal it is necessary to make an incision which should reach from a little above the site of the gland to about half-way down the scrotum. As this incision is deepened over the line of the canal, the aponeurosis of the external oblique

3

muscle will be encountered, and in the majority of instances it will need division as·far as the limits of the skin-wound. A very free exposure of the testis is desirable, so that it can be dealt with thoroughly. The condition of the processus vaginalis testis now requires consideration. Careful examination of the cavity after it has been opened will reveal whether or no it communicates with the general cavity of the peritoneum.

While attempting to find an aperture leading into this region it should be remembered that the passage may be a curved one, and that the probe needs to be gently passed in several directions before its right track is discovered.

Should such a communication exist, there would always be the liability of infection extending to the general cavity of the serous membrane if by misfortune the wound became septic.

This patent process of peritoneum has to be considered as consisting of two parts—an upper, which will require obliteration, and a lower, which is to go to form a tunica vaginalis for the testis after transplantation.

In order to accomplish these ends, the process is to be carefully divided in a circular manner close above the testis, the cord being adequately protected from injury. The higher segment is then dissected up until the site of the deep abdominal ring is reached, and the parietal peritoneum, even within this aperture, is to be loosened for a short distance around. A full examination of the interior of this tube-like process is thus obtained, proving it to be empty, and, traction having been made upon it, its highest part is then transfixed and tied in two halves with a fine silk ligature. Section is made below the site of the ligature, and the stump is allowed to retract within the abdominal wall.

The other portion of the peritoneal pouch, by a few fine stitches, is readily closed to form a true tunica vaginalis testis.

The next step in the operation consists in the freeing of the testis and its cord from the tissues in which they lie. This stage is one of the most important, as it depends to a very great extent upon the freedom that can be safely

secured whether it can be induced to pass to its new resting-place.

The adhesions which fix the testis are of two kinds—the natural, and therefore congenital; and the abnormal, and therefore acquired.

The former exist as those which unite the gland in its tunic to the parts that lie behind and below it, and those which attach the cord to the similar tissues. These are both the remains of the plica vascularis. Sometimes they are thick and very vascular, and at others thin and almost bloodless.

The acquired adhesions are those which are likely to be in evidence when there has been one or more attacks of inflammation in the arrested gland. They occur more often within the tunica vaginalis than outside this cavity, but in either situation they may have a deterring influence on the ease with which the testis can be displaced downwards. In the actual separation of these adhesions, whether the natural or the unnatural, the greatest caution must be exercised not in any way to interfere with or injure the structures constituting the spermatic cord.

The fact that the vas deferens may loop down for some distance below the site of the testis is always to be borne in mind, for the dissection of the tissues about the lower part of the processus vaginalis is fraught with danger to such a portion of the excretory duct, division of which is almost sure to result in a complete atrophy of the gland. Therefore the spermatic cord should be very clearly defined and its constituents ever kept in view.

It is only after free section of all the fibres that hold the testis in its improper site that a full estimate can be made of the extent to which the organ can be pushed down, drawn down, or otherwise manipulated in the direction of the new bed which it is intended that it should occupy.

The utmost gentleness must be exercised in the attempt to get the testis to pass into the scrotum, for any undue strain upon the cord, and thus on the vessels contained therein, will greatly militate against the subsequent growth of the gland.

The testis being freed and found capable of passing into the scrotum, at least to a point below the superficial ring, but preferably as far as the lowest limits of the bag, it only remains to fix it in such a manner that it may not be retracted.

On the other hand, supposing that the mere freeing of the organ by the division of the adhesions does not allow it to be sufficiently drawn upon without too much tension on the cord, there is an expedient which may be adopted in order to gain some further length, as it were, of the cord. This is the careful dissection of the vas and the vessels from the back of the epididymis so as to allow of the testis being inverted and to hang down with the globus major as the lowest part. In this way the length of the testis itself is added to that of the cord, and this may enable the operator to bring the organ into the upper part of the scrotum.

It is, however, remarkable that there are very few records of the after-history of these cases, and it is questionable whether they are satisfactory.

In certain instances, although the vas deferens is long enough to allow the gland to be brought well down, the spermatic vessels are too short to admit of the displacement, and it has been advised in such cases to cut through the whole of the vascular channels and to free the testis from all its attachments save that of the vas. It seems to be hardly desirable to thus deprive the organ of its blood-supply for the sake of half an inch or less further descent.

The testis having been brought to the utmost limit downwards that the length of the structures which tether it will permit, it is necessary to prepare a bed for it in the loose tissues of the scrotum. This is accomplished by a little dissection through the lower part of the original incision. Care should be taken to leave a sufficiently thick pad of tissue at the bottom of the scrotum, in order that the retaining suture may have a reasonable amount of material on which to take a firm hold. However, the thickness of the mass need not be great should it be deemed advisable to pass the anchoring suture through the skin itself.

After the preparation of the bed, the lowest limits of the

scrotum are to be invaginated so as to approximate them to the position of the testis if that organ is still lying at some distance. Then a suture of moderately fine silk is passed well into the substance of the testis, or, in some cases, of the epididymis, and a good hold thus obtained upon it. The stitch is carried now into and across the tissues at the bottom of the scrotum, and brought out to be tied close below the testis. It will now be seen whether or not there is mischievous tension on the suture. If there should be, then there will be a great tendency for the tissues of the scrotum to remain invaginated or even to become more so. Upon the amount of this the prognosis of the case may be fairly judged.

In order that there may not be this incurving of the scrotal tissues, and yet a secure fixing of the testis, it has become the practice of some surgeons to pass the two ends of the suture, which has penetrated the substance of the testis, through the skin at the lowest part of the scrotum, and then to tie them over a pad of antiseptic gauze, and to withdraw the suture some few days afterwards. Probably, if this method is used, a suture of salmon-gut is best, for the great strength renders it efficient and the extreme smoothness makes its withdrawal an easy matter.

The advantage gained by this procedure, although theoretically appreciable, is practically almost infinitesimal. The pad of gauze may, indeed, decrease the amount of invagination of the scrotum by its very bulkiness, and thus may increase the strain upon the spermatic cord, and as the stitch has to be in the end removed, there would naturally be a greater liability for the testis to be afterwards retracted than when it is left tethered by a permanent suture.

In order to still more effectually prevent the retraction of the testis or the invagination of the scrotal tissues, some have advised the adjustment of a wire cage around the scrotum, to a bar of which is to be attached the suture that is to hold the gland in its new bed until the organ has become more or less firmly fixed in the fresh site. Another ingenious method used is to bring the suture holding the testis through the skin of the lowest part of the scrotum,

and to fix it to the skin of the inner side of the upper part of the thigh, or even to bring the lower edge of the gland itself through the skin of the scrotum, and to suture the testicular tissue to the skin of the thigh, a separation afterwards being effected.

But it is the absence of definite records of the success or these manœuvres that tends to legitimate doubt as to their efficiency, and the observation of a considerable number of cases in which failure of the various methods that are in vogue favours the conclusion that operative measures are not always followed by the results that could be wished for. There would appear to be a want of real growth and development of the gland, and this is the occasion of great disappointment both to the surgeon and the patient. But this expression of opinion must not be taken as negativing altogether the value of an attempt to bring the inguinal testis down as far as possible in the majority of instances, but it should perhaps indicate rather that the prognosis as to the subsequent usefulness of the organ is to be a very guarded one.   The patient will doubtless in after-life be gratified that even a vestige of a gland has been preserved to him in the scrotum, provided that the testis has not in the meantime given him much annoyance.   In cases where inconvenience has continued, the organ can always be removed at any future period.

The testicle having been fixed in whatever manner the individual operator deems best, and all hæmorrhage having been carefully arrested, it remains to close the wound with interrupted sutures of silkworm-gut, no drainage being employed, and to apply a gauze and collodion dressing.

Some slight amount of orchitis generally follows the operation, but if the utmost gentleness has been exercised in the manipulations it should not be harmful to the glandular tissue.   Provided that asepsis has been maintained, the dressing may be left untouched for at least a week, when it should be removed and the superficial sutures cut out.

If the fixation stitch has been brought through the skin at the bottom of the scrotum, this is usually relaxed at the

end of the second day, generally without much, if any, disturbance of the dressing.

In regard to the ultimate results of the operation, the first point to be considered is the question whether the testis remains as a rule in its new position, and the second whether, supposing that it does so remain, it subsequently undergoes further growth and development.

There can be no doubt that when the testis, from the anatomical conditions, is readily brought down into the scrotum without undue strain it will remain in its fresh bed and become permanently fixed there.

In a certain proportion of such cases it will grow and develop so as to become in the future a thoroughly efficient organ. The exact number of instances in which this happy termination does occur is unknown, because there are no proper statistics on the subject. But from the after-inspection of not a few cases where the testis has been transplanted into the scrotum at the same time that a radical operation has been performed upon the accompanying inguinal hernia, it has been found that the testis has a very great tendency to mount again into the region of the superficial ring, if not actually into the inguinal canal itself, particularly if the case is observed some years after the initial operation. As has already been noted, such a position of the testis does not necessarily mean that the patient is dissatisfied with the result of the procedure, although the operation may, from the surgeon's point of view, be a failure.

With regard to the second half of the question, if the testis does remain in position, it will in some instances undergo development; but, on the other hand, should it be retracted, it will as certainly become more atrophied, or, at any rate, not develop. There is here, once more, a significant want of definite record of the subsequent history of these cases, and those that have been traced have not given the operator too much satisfaction.

Transplantation of the Testis lying just below the Superficial Abdominal Ring.

Most, if not all, of the remarks that have been made with regard to the transplantation of the inguinal testis apply with equal force to that of the gland which has found its way as far down as to lie just below the site of the superficial abdominal ring.   Here, if anywhere, the testis is likely to become nipped in the aperture, and so to cause the patient a considerable amount of discomfort, and, unless there is very good reason to believe that it can be brought much lower, and remain there, it is better to remove rather than transplant it.

Transplantation of the Perineal Testis.

When the testis has passed into the region of the perineum, especially if it has reached a position near the margin of the anus, it has in reality descended even further than the normally placed testis, and therefore the length of the cord is proportionately greater.   It thus happens that the transplantation of the perineal testis into the scrotum is a comparatively easy matter, provided that the corresponding half of the scrotum is sufficiently developed to receive it.

It should also be remembered in this connection that the testis which has entered the perineum is frequently but little less developed than is the properly placed gland, and only requires its transference into the scrotum to place it in a position of comparative safety.

In performing the operation of transplantation of a perineal testis, an incision is first made over that part of the spermatic cord which lies in front of the body of the os pubis, and this structure is to be freely exposed.   Then, by a little gentle traction, it is usually possible to bring the testis from its bed in the perineum up towards the wound. Generally the gland will be found tethered by a fairly firm band of tissue—the remains of the fasciculus of the gubernaculum testis—which has succeeded in drawing the testis into its abnormal position.   Sometimes the lower attach-

ment of the band is to the tissues at the margin of the anus, at other times to the tuber ischii itself. ·

With the testis well drawn up, this band can be reached and divided, the section doing much towards freely separating the gland, so as to render its transference easy. If there is not sufficient room in the original incision for the dissection to be made, it is only necessary to somewhat enlarge the' primary wound.

When the testis has been freed, another prolongation of the incision, if needful, is made in the direction of the scrotum, and a bed prepared in the scrotal tissues for the reception of the testis.

This method of performing the transplantation through but one incision has the disadvantage that in some instances it brings about a failure, on account .of the fact that the amount of tissue which exists between the old and the new bed is so small that there is a great tendency for the organ to slip back again into its old position. In order to avoid this mishap another method may be employed.

This consists of using an incision over the testis as it lies in the perineum in order to free the gland, and then of making a small puncture in the lowest part of the scrotum. Through this is thrust a pair of dressing forceps until the points protrude at the upper part of the primary incision. The forceps are now opened so as to produce a wider passage. They then grasp the lower end of the displaced testis, and by gentle manipulation it is brought down into the canal formed in the tissues of the scrotum. A single stitch will now suffice to fix it in its new cavity, such suture being also carried, if necessary, into the skin of the perineum behind the scrotum to prevent any retraction of the gland. In order to insure asepsis, the smaller the incisions through which the transplantation is effected the better. In some cases, possibly, drainage may be advisable, but it should be avoided, for it always leaves an open door for infection. The dressing and after-treatment is the same as when an inguinal testis has been transplanted.

It is best to defer the operation upon a perineal testis until the child has reached the age of three years, for it will then

be easier to control the patient, and thus insure a greater certainty of primary union. Further, the delay will not be prejudicial to the gland, seeing that the perineal testis has but little tendency to atrophy unless there is a superadded inflammation.

Treatment of Testes within the Abdomen which have been the Seat of Inflammation.

In certain instances in which abdominal testes have been the seat of inflammation they may remain the seat of tenderness and pain. This is particularly likely to manifest itself after coitus. In cases of this kind the actual pain may be caused by some adhesions that have been formed owing to the inflammatory attack, and relief may be afforded only by the exposure of the organs by laparotomy and their being freed and allowed to move easily within the abdominal cavity. In other cases excision is indicated should the organ give rise to very much trouble.

CHAPTER IV.

NEW GROWTHS OF THE IMPERFECTLY DESCENDED TESTIS.

A FULLY descended testis may be the site of new growths, both of an innocent and of a malignant nature. The imperfectly descended gland is an organ that from its usual arrest of development or possible abnormal development would apparently be likely to be even more frequently associated with the formation of new growths within its substance than the normally placed organ. Therefore the occurrence of neoplasms in the testicular tissue of the retained gland is a matter of exceptional interest alike to the pathologist and the surgeon.

It may be premised that most of the growths that are met with in connection with the fully descended organ are also found associated with the testis that has failed to reach its usual position or has passed into an abnormal abode. Such growths may be conveniently classified as the innocent and the malignant.

Innocent New Growths of an Imperfectly Descended Testis.

These are either solid or cystic.

Solid Innocent New Growths.—Perhaps nowhere so often as in a testicular new growth is it so difficult to determine on the evidence of microscopic examination whether or not a certain neoplasm is of a malignant or of an innocent nature. New growths in the testis tend to be so mixed that many a time their real character is much overshadowed. When the question of solid growths of the imperfectly descended testis is taken into account there cannot be a great amount

of uncertainty, from the fact that they are of extreme rarity so far as truly innocent forms are concerned.

The fibromata, myomata, myxomata, osteomata, chondromata, and lymphadenomata, are conspicuous by their absence when the imperfectly descended testis is under review. It is extremely doubtful whether there are any museum specimens of these new growths. Enlarged testes are met with which have not reached the scrotum, but they, as a rule, owe their increase in size to the fact that they have been the site of repeated attacks of inflammation. Microscopically they show evidence of more or less extra deposition of fibrous tissue, and that altogether apart from the proportionally greater amount of it so frequently present in an imperfectly descended organ. Both the fibrous tissue stroma and the coverings of the gland are augmented so that the tunica vaginalis may be much thickened and rigid.

In a certain sense this increase of fibrous tissue might be looked upon as being a variety of fibroma, but it is not the form that is usually so described.

Cystic Innocent New Growths. — These may be classified under four headings : (1) Cysts in connection with the epididymis ; (2) Cysts in connection with the testis proper; (3) Cysts in connection with fœtal relics ; (4) Dermoid cysts (teratomata).

Here, as with solid new growths, there is a great tendency for cystic tumours of the testis to be mixed in their character. There are, however, certain cystic conditions that are definite in their form, and some of these have been met with in the imperfectly descended testis, both in the human subject and in animals.

Such cysts may be conveniently classified and reviewed under the four headings just alluded to.

1. CYSTS IN CONNECTION WITH THE EPIDIDYMIS.

Cysts which are derived from the epididymis are of two varieties, the small and the large. In the former the cysts never tend to enlarge to any but a comparatively small size, certainly not greater than that of an ordinary marble. They are not of much clinical importance. In the latter there is

PLATE XXI.

FIG. 39.—A CYST FOUND
IN CONNECTION WITH
AN INGUINAL TESTIS.

(Guy's Hospital Museum,
No. 2076.)

FIG. 41.—A DERMOID CYST OF TESTIS RETAINED
WITHIN THE ABDOMEN OF A HORSE. (CADIOT,
1893.)

a, testis and annexa as removed; b, section of testis;
T, testis; E, epididymis; QE, tail of epididymis;
CV, vas deferens; O, nodule of osseous tissue;
P, hair matted together by sebaceous material.

FIG. 40.—CYSTIC DEGENERATION
OF AN ABDOMINAL TESTIS OF
A HORSE. (CADIOT, 1893.)
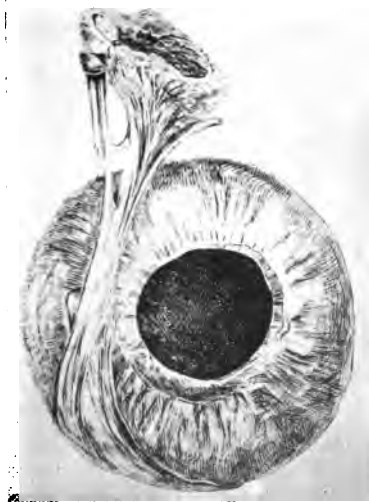
FIG. 42.—CYST OF RETAINED TESTIS
OF AN IMPERFECTLY DEVELOPED
RAM, REMOVED FROM THE PELVIS.

(Royal College of Surgeons of England
Museum, No. 4217a. 'Transactions of
the Pathological Society of London,'
vol. xl., p. 463.)

a progressive tendency for the cysts to grow, and they may assume such proportions as to become of very definite clinical interest.

SMALL CYSTS OF THE EPIDIDYMIS.—Such cysts in the fully descended testis are uncommon before the age of forty, and almost unknown before puberty. They may be met with also in the imperfectly descended testis. They occur either as sessile or pedunculated growths. When they take the latter form they occasionally give rise to the production of loose bodies in the tunica vaginalis. Not infrequently they are multiple and sometimes very numerous.

When pedunculated they cause small balloon-shaped swellings, very firm to the touch, almost giving the impression that they are of a solid nature. When sessile they raise the serous membrane so as to produce small oval or hemispherical tumours, also with a feeling of extreme tenseness. If punctured, a clear fluid as a rule escapes, which but rarely contains spermatozoa, even when in association with a fully developed testis. It is possible that the rupture, traumatic or otherwise, of one or more of these small cysts may lead to the production of a vaginal hydrocele on account of some irritation set up by the extravasated fluid.

Causation.—These small cysts owe their origin to one of two sources: either they are involution cysts, due to the distension of a previously existing cavity, or they are connected with some fœtal remains, and are therefore cysts of congenital origin. If they were derived from the blockage and dilatation of the ducts or tubes of the epididymis they must be formed in the depths of this structure, and gradually reach the surface as they enlarge, there to elevate the serous membrane and in some cases to become pedunculated. possibly as the outcome of the almost constant movement to which they are subjected. Further, should this view of their origin be correct, it would be thought that there ought to be a definite communication between the ducts of the epididymis and the cavity of the cysts themselves. It is extremely doubtful whether such ever exists, for by careful injection of the ducts with mercury none has ever been

shown to penetrate the interior of the cyst, and it is but rare to discover any trace of spermatozoa in the fluid contents of the cyst.

But, in spite of these facts, it does not necessarily mean that a communication may not have existed at an earlier period in the formation of the cyst than the one that was taken for the injection experiment, and that the aperture may have become obliterated. Spermatozoa may in time, moreover, become completely disorganized in the fluid in which they lie. The lining epithelium of the cyst wall as a rule bears a close resemblance to that which lines the ducts of the epididymis. The senile changes which occur in the epididymis when the testis is fully descended, and the similar changes in the testicular tissue of the organ that has failed to reach the scrotum, especially when it has been subjected to repeated attacks of inflammation, both go to prove that there is an increase in the interstitial connective tissue, which, by a process of contraction, to which it is ever prone, may bring about the obliteration of some ducts, with a dilatation of that portion which remains patent.

With regard to the theory that these small cysts of the epididymis owe their origin to the dilatation of some fœtal remains, such as traces of the Müllerian duct, in favour of it may be advanced the fact that the enlargements occur close by the spot where such remains are likely to be left, and against it is the knowledge that they seldom occur in early life, a period of existence in which it would be thought that they would have been common.

These small cysts of the epididymis seldom, if ever, cause any annoyance, and are of but little importance, apart from the fact that it is possible that they may play a part in the production of some of the instances of vaginal hydrocele.

They are not generally found in the living subject from the symptoms which they occasion, but only when the organ is exposed during the course of a radical operation upon an accompanying hernia or vaginal hydrocele.

LARGE CYSTS OF THE EPIDIDYMIS.—These have their origin quite within the substance of the epididymis in the majority of instances, and are probably closely connected with the

seminal tubules or the ducts of the epididymis. They are usually single, have a tendency to increase in size so as to assume at times considerable proportions; they often contain spermatozoa, and can be readily diagnosed without dissection. They are generally found during the active period of the existence of the testis, and are most common, therefore, at an earlier age than are the small cysts already described.

The fluid that they contain is, as a rule, limpid and colourless, or slightly milky or soapy in appearance. Occasionally the contents may be straw-coloured, more like the fluid met with in an ordinary hydrocele.

Causation.—Again, as was the case with the smaller cysts, there are two theories as to the origin of the larger cysts of the epididymis.

They may be derived from the dilatation of a seminal tubule, one of the vasa efferentia, one of the ducts of the epididymis itself, or in the sac that may be formed by the inflammation produced after the rupture, traumatic or otherwise, of a seminal tubule. There is no doubt about the fact that spermatozoa are the usual inhabitants of the fluid contained within these cysts, that there is often a definite communication between the sperm-producing testis and the attached cyst, and that the cyst is in close relationship to the epididymis.

The origin of these cysts from fœtal remains is undoubted in some instances, but in such cases spermatozoa will not be found in the fluid.

Large cysts are not common in connection with the imperfectly descended organ.

2. CYSTS IN CONNECTION WITH THE TESTIS PROPER.

That the tissues which form the testis proper can be the ground for the origin of cysts is a fact that is well recognised.

They have for the most part been designated simple cysts or cystic fibromata of the testis. They are found not only in the fully descended organ, but also in that which has been arrested, and this not alone in the human subject, but also

in the lower animals, occurring, perhaps, more frequently in the latter than in the former.

These cysts may produce well-marked swellings, supposing that the testis has been arrested at some spot outside the abdominal cavity, or they may occasion an abdominal tumour. It must always be borne in mind that many of the cysts found in connection with a testis are in reality formed in a malignant deposit in the same.

3. Cysts of the Testis that have their Origin in Fœtal Remains.

Attention has already been drawn to the fact that cysts in connection with the imperfectly descended testis, as well as those in association with the fully descended organ, are sometimes derived from the dilatation of some of the fœtal remains that are present about the testis.

These may be classified as follows: (*a*) The hydatid of Morgagni; (*b*) Wolffian tubules; (*c*) vasa aberrantia; (*d*) paradidymis.

Here, again, these cysts are found also in the lower animals as well as in man.

4. Dermoid Cysts (Teratomata).

Dermoid cysts of the testis have undeniably been seen, although there is no doubt that some of the recorded cases have been rather those of a dermoid cyst of the scrotal tissues than of the testicular body.

In the human subject a true dermoid cyst of the imperfectly descended testis does not appear to have been met with, but they are not by any means uncommon in the lower animals, and particularly in the stallion. In these latter they have been shown to present similar characters to the ordinary dermoids, so-called, found in the human ovary, and probably their origin is somewhat the same. They may, indeed, be an attempt on the part of Nature *to* produce a descendant from germinal epithelium which has remained from the primary genital mass, but undifferentiated, and this abortive development is without the help of the union of cells of the two sexes, and results in the formation

of the heterogeneous mass of epithelium, sebaceous matter, teeth, ossifying cartilage, bone, and hair, etc.

It is conceivable that the testis, and more especially the imperfectly descended one, may contain the same or similar cells to those that the ovary does, and from which this curious formation takes its origin.

Lastly, it must always be remembered that cysts may arise in connection with malignant disease of imperfectly descended or migrated testes, though such seem to be much rarer in them than in the fully descended glands.

Malignant New Growths of the Imperfectly Descended Testis.

Both sarcoma and carcinoma may attack an imperfectly descended testis, but the mesoblastic new formation seems to be of rather more frequent occurrence than the epiblastic.

SARCOMA OF THE IMPERFECTLY DESCENDED TESTIS.

By sarcoma is understood a new formation of cells of an embryonic type and of mesoblastic origin, in which the cellular constituents predominate over the intercellular substance. Sarcoma of an imperfectly descended testis conforms fully to this definition.

Frequency.—Sarcoma of the testis, whether of the fully descended or of the partially descended organ, is a comparatively rare disease. Considering that every male, except an infinitesimal minority, has at birth two testes, wherever they may be situated, it follows that the number of testes that might become the seat of a new growth of a malignant character is enormous, yet the instances of such lesions admitted into most general hospitals are decidedly few. For instance, out of about 4,200 male cases admitted annually into a large London hospital, only an average of two each year for twenty years suffered from a malignant growth of the testis.

It is, however, a matter of extreme difficulty to satisfactorily determine whether a testis that has not reached

4

the lower limits of the scrotum or has passed into an abnormal position is proportionately more liable to become attacked with sarcoma than one which is situated in its usual place in the scrotum.

In a close examination of 48,000 males afflicted with hernia, 854 had imperfect descent of one or both testes, or one male in every 56 males suffering from hernia was also the subject of imperfect transition of the genital gland, which is, roughly, 2 per cent. Consequently, it would appear that, seeing instances of imperfect descent are not thus so very uncommon, sarcoma of the arrested testis should occur in a distinctly higher proportion than in the fully migrated. But that it is far below the average is evidenced by the fact that in forty cases of sarcoma of the testis admitted in twenty years into a large hospital, in only one instance was the testis imperfectly descended, and in that case it was retained within the abdomen. Further, in the 854 cases just alluded to no instance of any new growth, whether malignant or innocent, was seen.

From these and other facts it would seem that the generally accepted statement that malignant disease of the imperfectly descended testis is more common than that of the normally placed gland cannot be substantiated.

Sarcoma is more common than carcinoma of the imperfectly descended testis, following only the rule that is true of the fully descended migrated organ.

Variety.—The forms of sarcoma that affect the testis when it has not reached the scrotum are similar to those that occur in the normally placed gland, although there are not apparently as yet on record instances of every variety.

The forms which have actually been met with are: (1) Round-celled, whether large or small; (2) spindle-celled; (3) mixed-celled; (4) myxo-sarcoma.

Chondro-sarcoma, lympho-sarcoma, and melano-sarcoma have not been recorded in connection with an imperfectly descended testis.

Round-celled sarcoma is undoubtedly the most usual form to be met with, and after this the mixed-celled variety. These two sarcomata are of rapid growth, commencing

PLATE XXII.
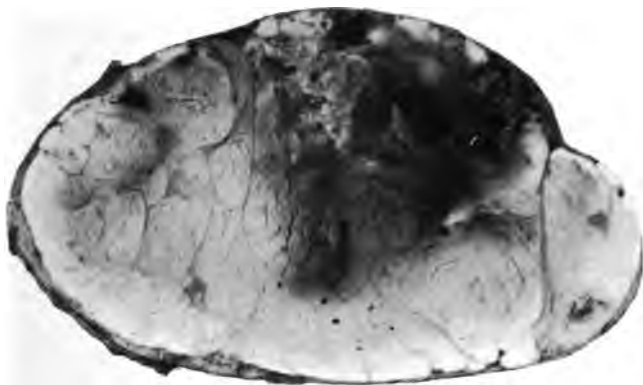
FIG. 43.—HALF OF A SARCOMATOUS TESTIS REMOVED FROM IN FRONT OF THE APONEUROSIS OF THE EXTERNAL OBLIQUE OF A MAN, AGED THIRTY-ONE.

It had been growing for two years. On removal, it was the size of an ostrich egg. From a case of Mr. E. C. Stabb's (Royal College of Surgeons of England Museum).
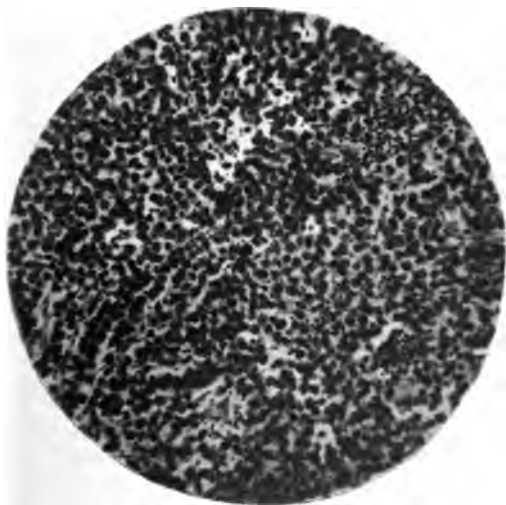
FIG. 44.—SECTION OF THE GROWTH SHOWN IN FIG. 43.

It exhibits a typical round-celled sarcoma.
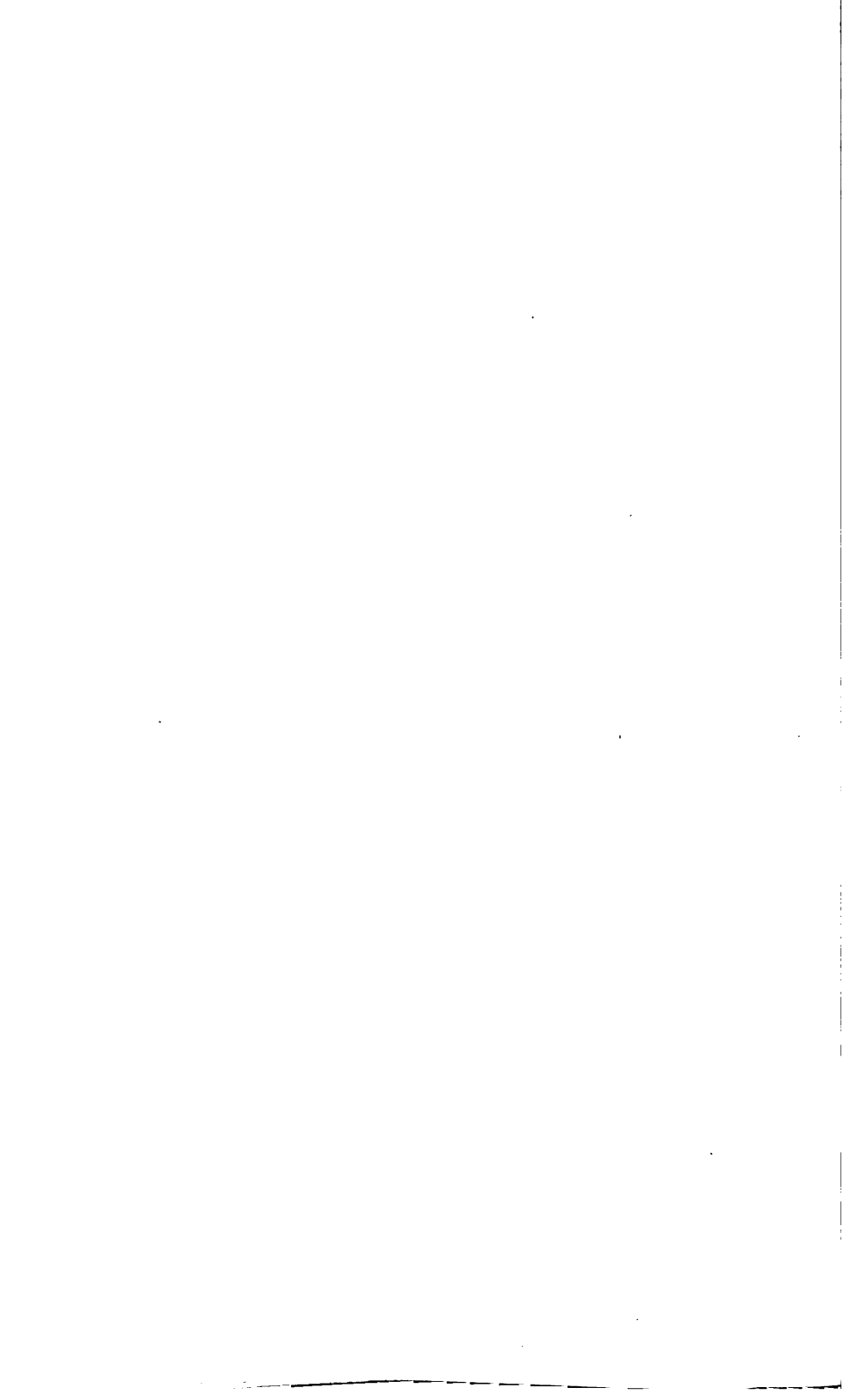
generally in the connective tissue of the body of the gland, being but rarely primary in the epididymis.

Morbid Anatomy.—At first the new growth is confined within the tunica albuginea of the testis, and is liable to be surrounded with fluid in the tunica vaginalis, which fluid is not infrequently blood-stained.

As the growth advances it transgresses the confines of the tunica and involves the surrounding structures. Usually, however, lymphatic glandular infection or secondary deposition in viscera has taken place before considerable local extension has occurred. The sarcomatous elements in the testis appear at the beginning in the connective tissue forming the walls of the ill-developed tubuli seminiferi and in the tissue which is found between these structures. The invasion of the round or spindle cells displaces the tubules further and further from one another, and at the same time compresses them so that their shape becomes completely altered, their lumen entirely obliterated, and their imperfect epithelial cell-lining destroyed. The occurrence of interstitial fibrous tissue in these sarcomata is not uncommon, and in some instances in a marked degree.

Occasionally myxomatous tissue is observed.

No instance of cartilage being present with the sarcomatous elements in an imperfectly descended testis has apparently yet been placed on record. This is a matter of some interest, seeing that cartilage is comparatively frequently found in the spindle and mixed-celled sarcoma of the fully descended organ. Usually there is extension of the disease along the lymphatic vessels, proceeding from the gland at a very early stage of the disease.

The testis is extremely rich in lymphatics. The minute vessels surround the tubules, and unite to form larger channels, which run in the septa between the compartments of the gland. Most of the lymph is conveyed by these vessels to the corpus Highmori, and thence by way of larger vessels, which constitute the lymphatics of the cord. The rest of the lymph is carried away by a network of vessels beneath the tunica vaginalis, communicating with another network under the tunica albuginea, and from both

of these situations channels run up to the hilum of the organ.

From four to six trunks accompany the spermatic vessels in the cord. Upon the right side they terminate by entering from two to four glands placed upon the inferior vena cava, just above the level of the bifurcation of the aorta. Further vessels leave these glands and pass to other glands and lymphatic tributaries between and behind the aorta and the cava, and finally empty into the receptaculum chyli. Upon the left side the first glands are found near the aorta and the left renal vein. From some of these glands efferent vessels pass to other glands, and these discharge their contents into the receptaculum chyli. The entire thoracic duct may be filled by carefully injecting the lymphatics of the testicle. Owing to the conveyance of infected lymph through the thoracic duct, the left supraclavicular lymphatic glands may in the end become involved, and this in malignant disease of either the right or the left testis.

Secondary growths resemble in every way the primary lesion. They may be found in the lungs, liver, kidneys, spleen, and peritoneum, in addition to the lumbar lymphatic glands. Bloodvessels, particularly the inferior vena cava, are sometimes the site of the secondary growth, thereby becoming blocked, and very seriously impeding the return of blood from the lower extremities. Œdema may also be caused by the direct pressure of the glandular enlargement upon the vessel near the renal region.

Further, growth may pass by direct extension to the tissues of the scrotum, through the superficial ring, to the cord, to the surrounding tissues of the inguinal canal, and to the peritoneum.

On microscopic examination of a round-celled sarcoma there will be seen large masses of embryonic cells, disseminated in the meshes of the connective tissue of the gland. It is difficult to say in many instances whether the trabeculæ present are in reality part of the new growth or whether they are furnished by the ill-developed or degenerated organ. Probably the latter is the more usual source of their origin.

Causation. — As in instances of sarcoma of the fully descended testis there is but little recorded that is of much value in the determination of the exact cause of the new growth in the body of the organ, so in the cases where the imperfectly migrated gland is attacked the history does not, as a rule, reveal any very clear factors that can be judged to be the causes, whether predisposing or exciting, of the lesion.

(a) *Age.*—Analyzing a considerable number of instances of sarcoma of an arrested testis, it will be found that it begins most frequently in the period between the ages of twenty and forty years, and is therefore a disease of middle life.

(b) *Side Affected.*—There does not seem to be any marked difference as to which side the new growth settles when it attacks the partially migrated gland.

This is not altogether in accord with the fact that the right testis is decidedly more commonly arrested than is the left. There is, therefore, possibly some reason why the testis on the left side, when it is only imperfectly descended, should become the site of the deposit of sarcoma, a factor which is not so strongly at work on the right side. What this is can be but pure conjecture.

(c) *Position of the Affected Testis.*—As the position that is most common for the testis to be retained is in the inguinal canal, so malignant disease, and particularly sarcoma, is usually seen in a testis which has not travelled further than the interior of this canal.

After this position, the abdominal inclusion is the next most productive of a malignant new growth, and this is not in accord with the fact that the next most common place for the testis to be arrested is just below the superficial ring.

(d) *Injury preceding the deposit of Sarcoma.* — A definite history of injury, such as a blow or a squeeze, is not infrequently given in the cases where sarcoma attacks the testis in the scrotum; but when the lesion is seen in the imperfectly descended testis such a predisposing cause is not nearly so clear. On the other hand, it must be remembered that the testis which lies in the inguinal canal is

subjected to numberless, though slight, occasions of violence, which may pass in the majority of persons without any notice being taken of them.

As has been discussed when inflammation of the arrested gland was dealt with, muscular effort, blows, and the extrusion of the organ suddenly through the deep or superficial abdominal ring, all contribute to the onset of inflammation, and possibly also of new formations.

When the testis is retained within the abdominal walls—that is, lies in the peritoneal cavity—it cannot be so exposed to the risk of injury, and yet it has been seen that the abdominal inclusion does not by any means protect the gland from the onset of malignant trouble. It is conceivable that the pressure to which the testis in the inguinal canal is so repeatedly subjected may produce such an effect upon the ill-developed gland as to induce some fœtal relic within it to start in malignant activity in the shape of a sarcomatous growth.

On the other hand, it is possible that some injury may result in the formation of reparative material, the cells of which may be arrested at that stage when they so closely resemble those of sarcoma that these latter may actually derive their origin from this source.

(*e*) *Previous Inflammation.*— Previous inflammation, even apart from that due to injury, is also apparently rare in cases of new growth.

(*f*) *Coexistence of Hernia.*—The presence of hernia, complicating the partial descent of a testis, is so common that it would not seem that it has much, if any, bearing upon the causation of sarcoma in the arrested organ. In the 854 cases of hernia with imperfect descent of the testis previously alluded to, there was not a single case of malignant disease of the gland.

Further, in a series of twenty-six cases of sarcoma of the arrested testes only two had hernia present, and in neither did the protrusion seem to have lent any help to the growth of the new formation. Two others had worn a truss for a supposed hernia, but only with a possible relation to the onset of the new growth in one.

But there is a fact that must be taken into consideration under this heading, and it is that so many instances of imperfect descent of the testis are mistaken for hernial protrusions, and a truss applied.

Also there is the fact that hernia, being so very usually present with a testis which has not reached its normal position, truss-pressure is undoubtedly in evidence in a considerable proportion of cases of sarcoma of the imperfectly migrated organ.

It is extremely doubtful, however, whether a truss worn over the inguinal canal, in the case of inguinal inclusion of a testis, really does produce harmful pressure on the gland, provided that the truss is of right construction and size.

On the other hand, the pressure of a truss, if applied over a testis that is lying just below the superficial abdominal ring, is ever prone to excite the onset of inflammation in the organ, but sarcoma of a gland so placed is rare.

(*g*) *Heredity*.—There is no evidence whatever that there had been any hereditary influence at work in any case of sarcoma of an imperfectly descended testis.

(*h*) *Developmental Causes*. — The persistence or not of embryonic traces or cell-elements—possibly such as might reasonably be termed ' rests '—in testes that have failed to reach their normal resting-place is a matter which requires a closer histological investigation, and for this purpose, among others, every imperfectly descended testis should be submitted to rigid microscopic examination.

Further, in every instance of castration for early sarcoma —and such should be the case with increasing frequency, whether of a fully or incompletely descended organ—the testis must be considered as likely to afford some light on this till now obscure subject. It is well recognised that vestigial elements in imperfectly developed organs are peculiarly liable to give rise to malignant growths.

Recently the careful microscopic examination of testicles removed from adults who were also the subjects of hernia associated with imperfect descent has proved again the existence of a remarkable augmentation of interstitial cells.

In one instance the left testis was removed from the

inguinal canal of a man of thirty-seven years of age, suffering from a left inguinal hernia of congenital origin. Castration was undertaken with a view to the radical cure of the hernia. Another testis was that from a man aged twenty-two years, in whom the organ was retained within the abdomen in the left iliac fossa, and accompanied by a left inguinal hernia.

The examination of the testicular tissue in these and other glands reveals two abnormalities :

Firstly, the seminiferous tubules are found to be ill-developed, and present no signs whatever of spermatogenesis.

Secondly, there is a very distinct increase in the interstitial cellular elements.

It is open to question whether these cells, which appear in so much larger number than they do in normally placed testes, have an epithelial or a connective-tissue origin. If epithelial, they might be the remains of the epithelial lining of aborted seminiferous tubules. Further, they might have their source from remains of the Wolffian body.

Although there does not at present seem to be sufficient evidence to definitely determine their origin, yet it would appear most probable that they owe their presence to mesoblastic rather than to epiblastic tissues.

The cells are somewhat like those found in the adrenal tissue, particularly the cortex of this organ, but it is doubtful whether they can be taken as the remains of any past structure, seeing that they are absent in the testes of the fœtus and young infants, though they put in an appearance before the attainment of the virile powers.

But, whatever their source and their physiological significance, there can be no doubt as to their interest from a pathological point of view. Given, then, that in certain cases, at least, of imperfectly descended testes there is an excessive development of these special interstitial cells, it may be justifiable to conclude that they are the starting-point of some of the new growths of the arrested gland.

As has been seen, the majority of the malignant growths of the imperfectly descended testis are of a sarcomatous nature, while those of the fully migrated organ are not

uncommonly epithelial in type. It is possible, therefore, that these interstitial cells are in reality an explanation of the origin and frequency of sarcoma of the arrested testis.

Signs and Symptoms.—When sarcoma attacks a testis which has not reached the scrotum, the onset of the new growth is gradual, and it may be attended with but little pain or other inconvenience. When the testis has passed beyond the confines of the abdominal wall an external tumour will be in evidence.

As a rule, seeing that the testis which is affected is most usually placed in the inguinal canal, the swelling can be observed in the inguinal region, lying above and parallel with Poupart's ligament and covered with the aponeurosis of the external oblique. The patient, however, may or may not be aware of its presence.

Later there may be some difficulty in walking, and pains may radiate down the thigh. When the tumour assumes any marked proportions, pressure symptoms are apt to supervene, with œdema of the lower extremity. When extension of the growth to the peritoneum has occurred, ascites makes its appearance.

The deposit of the neoplasm in the viscera of the abdomen, the liver, spleen, kidneys, and, above all, the lumbar lymphatic glands and in the thoracic organs, particularly the lungs, brings on cachexia, exhaustion, and death.

When the affected testis lies within the abdominal cavity, there will be an increasing tumour found in most instances in the lower portion of the abdomen, and having a moderately firm consistency, with very little mobility, and tending to produce pressure symptoms.

Such intra-abdominal growths sometimes set up peritonitis and induce intestinal obstruction, and cause death from this lesion. Septicæmia may also terminate these cases.

Diagnosis.—The chief conditions from which sarcoma of an imperfectly descended testis lying in the inguinal canal has to be differentiated are inflammation of the arrested gland and a hydrocele of its tunica vaginalis.

In the inflammatory attack, the onset is much more sudden, the pain greater, and the enlargement but slight.

Further, there is no tendency for the swelling to steadily increase in its bulk, but rather to gradually diminish.

On the other hand, a hydrocele may much more closely simulate a new growth, and, in fact, the collection of fluid may accompany the same.

Here the swelling is firm, of equal consistence in all parts, and with but little tenderness on pressure and with a disposition only to increase comparatively little in size. The tumour, moreover, fluctuates, and if a considerable quantity of fluid has collected translucency may be obtained. In all cases of doubt, however, the swelling should be explored with a fine trocar and cannula, and, if fluid is withdrawn, what is left behind in the canal must be most carefully examined, in order to determine whether the testis is the site of a new growth. If the fluid which is evacuated is blood-stained, a very grave suspicion that the organ has been invaded by the cells of a malignant growth must be entertained.

Innocent growths of the imperfectly descended testis are so rare that their differential diagnosis from malignant neoplasms scarcely requires discussion. In all cases of doubt the tumour should be exposed by incision and the exact state of the testis made out.

Prognosis.—The prognosis of sarcoma of an arrested testis is very serious. Untouched the lesion must inevitably lead to a fatal issue. Early castration gives the only hope of permanent benefit, and even this, from the record of published cases, seems to be very infrequent.

In most instances an infection of the lumbar lymphatic glands takes place before any attempt at removal can be carried out.

Although but few cases succumb as the direct outcome of the operation, yet there are not many definite histories of a non-return of the disease for a longer period than the three-year limit. In most instances death occurs within one year of the removal of the diseased organ.

These facts would strongly point to the necessity for early exposure and excision of all testes arrested in the inguinal canal which show any signs of becoming increased in size.

Unfortunately, when the testis is retained within the

abdomen, the detection of any enlargement of it is a matter which cannot be determined until it has assumed such proportions that the likelihood of cure by its removal is highly improbable.

Treatment.—Castration is the only treatment for sarcoma of the arrested testis. Thorough asepsis is essential, for in the earliest attempts to rid the patient of his trouble the fatal termination was precipitated by a septic infection of the peritoneum through the patent processus vaginalis. Beyond the possibility of this complication, and perhaps, also, of hæmorrhage, there is very little more danger attaching to the operation of removal of the inguinal testis than there is in that of castration for a similarly diseased testis normally situated.

EXCISION OF THE INGUINAL TESTIS THE SEAT OF SARCOMA.—A free incision is to be made in the line of the long axis of the tumour, that is—above and parallel with Poupart's ligament. After division of the skin and superficial fascia, the aponeurosis of the external oblique has to be slit up in the extent of the wound, thereby exposing the diseased organ. If this should be of any size the abdominal wall covering it may be considerably thinned, and care must be taken not to incise the tumour while laying it bare. As a rule it is well to attempt the removal of the gland without opening its serous coat. Some dissection will soon free the latter from its bed, and disclose the position and character of its pedicle. Very little, if any, hæmorrhage will have been encountered in these early stages of the operation, and what there is readily yields to pressure.

The tumour, being now free, can be lifted up by an assistant, and the spermatic cord, with its vessels dilated in proportion to the bulk of the tumour, is generally found entering the upper and outer angle of the testis. At this stage in the operation it is always well to divide the peritoneum surrounding the entrance of the cord into the extraperitoneal tissue of the iliac fossa, in order to determine the presence or not of a communication with the general cavity of the serous membrane. Should such be discovered

to exist, the aperture is to be closed with fine silk sutures, so as to prevent any descent of viscera.

The spermatic cord forming the pedicle of the tumour has now to be dealt with, and some care must be taken in satisfactorily securing this structure. The enlarged testis having been raised and the cord thereby made evident and thus put on the stretch, a blunt aneurism needle, or a pedicle needle, unthreaded, is made to transfix it as high up as possible, but without running any risk of injury to the parietal peritoneum. The needle is then threaded with strong sterile silk and withdrawn, bringing with it the loop of the ligature. This is then divided, the two portions interlocked, the drag on the tumour diminished, and the two ends of each ligature are tightly tied, thereby enclosing the whole thickness of the pedicle. For still greater security, it is advisable in a thick pedicle to bring one of the pair of ends, after they have been tied, right round the entire pedicle and retie them. A pair of pressure forceps is then applied to the pedicle on the distal side of the ligature, and the tissue cut through with a scalpel or pair of scissors about half an inch on the distal side of the ligature close beyond the site of the forceps. The surface of the severed cord is to be inspected to make sure that there is no bleeding, and if this is so, the forceps are removed and the stump allowed to retract.

A repair of the inguinal canal can then be performed in the manner usual in a radical operation upon an inguinal hernia. The skin incision is closed by interrupted sutures of silk-worm-gut, no drainage being needed. The dressing and the after-treatment of the case is the same as that for the removal of the undiseased inguinal testis.

Attempts may be made to remove a longer piece of the vas deferens by either forcible traction on it or by enlarging the inguinal incision. Some operators prefer to ligature the individual constituents of the cord separately, but although this may be a fairly easy method of dealing with them in the normally placed testis, even when it is the seat of a new growth, yet it may be very difficult when the organ is lying in the inguinal canal.

PLATE XXIII.

FIG. 45.—SECTION OF A ROUND-CELLED SARCOMA OF A TESTIS
REMOVED FROM THE ABDOMEN OF A MAN.

Case of Mr. J. B. Pike's. (× 50.)

FIG. 46.—SECTION OF A CHONDRO-CARCINOMA OF A TESTIS REMOVED
FROM THE INGUINAL CANAL OF A MAN. (× 50.)

A case of Mr. M. H. Way's. Reported in the *Guy's Hospital
Gazette*, December 16, 1899, p. 533.

Should the disease have passed beyond the confines of the tunica vaginalis, it would become necessary to dissect away all the infiltrated tissues, a procedure which is usually imperfectly carried out, from the nature of the growth, and is generally followed by a rapid local recurrence.

CARCINOMA OF AN IMPERFECTLY DESCENDED TESTIS.

Frequency.—A new growth springing from the epithelial elements of an imperfectly descended testis is not so frequently observed as is a new growth derived from the connective tissue of the gland, and this is a fact of considerable pathological interest. It is probable, moreover, that many of the cases which have been recorded in older medical literature as ' cancer,' ' encephaloid,' ' medullary disease,' and other somewhat vague terms, were in reality instances of sarcoma rather than of carcinoma.

Varieties.—The forms of carcinoma that are said to have been met with in the imperfectly descended testis are encephaloid or medullary, scirrhous and colloid.

The cells are spheroidal, oval, or polygonal. They are abundantly rich in protoplasm, and do not have very clear outlines, both of which facts are strong evidence of their epithelial origin.

Causation.—The ill-developed imperfectly descended testis has marked histological characters of its own, as has already been pointed out. In connection with carcinoma, it will be observed that there may be two sources of origin of the growth from epithelial cells—one the imperfectly formed epithelial cells of the tubules, and the other the ' interstitial ' cells in the stroma, if these latter, indeed, are of epithelial origin.

The former is, however, the more probable source of the cancerous growth. The reason, again, why carcinomatous disease of an arrested testis is comparatively infrequent may be due to the fact that there is so little active epithelium to be found in these ill-developed organs.

In the fully descended gland the tubular epithelium is constantly, between puberty and the involution of the organ,

undergoing division and subdivision for the formation of spermatozoa, and this is such a condition as to enhance the likelihood of the onset of new formation.

(*a*) *Age.*—While sarcoma of the imperfectly descended testis occurs most usually between the ages of twenty and forty, carcinoma is, on the other hand, perhaps more usual a decade later—that is to say, between thirty and fifty.

Malignant disease, therefore, of the arrested testis, whether it be sarcoma or carcinoma, appears to be a lesion of middle life.

(*b*) *Side Affected.*—The two sides of the body are as frequently affected the one as the other.

(*c*) *The Position of the Testis.*—Of the more recent cases in which a microscopic examination has revealed the presence of carcinoma, the testis has been found in the abdomen, the inguinal canal, and just below the superficial ring.

There is no recorded case of carcinoma of a testis placed in the perineum or in Scarpa's triangle.

(*d*) *Injury.*—There would seem to be some association with the onset of carcinoma and an injury to the retained testis, and this particularly when the testis is arrested in the inguinal canal.

(*e*) *Previous Inflammation.*—This factor, like that of previous injury, has some, but not any very definite, influence on the incidence of carcinoma of the arrested testis. Coexistence of hernia, whether real or supposed, does not seem to have been at all common, and therefore there is no very clear evidence that the wearing of a truss has any bearing upon the causation of an epithelial new growth.   ·

(*f*) *Heredity.*—In a few cases there has been some history of malignant disease in a former member of the family.

Signs and Symptoms.—These are almost identical with those that have been already described under the heading of Sarcoma of the Testis (p. 57).

Diagnosis.—It is impossible before the growth has been submitted to microscopic examination to be sure whether it is of a sarcomatous or a carcinomatous nature. The diagnosis, therefore, so far as the case goes before operation, can only be that of a malignant growth of the testis. The

other conditions with which this may be compared have been dealt with on p. 57.

Prognosis.—If it could be so, the prognosis of carcinoma is even more grave than that of sarcoma.

Secondary glandular infection is almost invariable, followed by other secondary deposits, cachexia, exhaustion, and death.

Treatment.—Nothing can be of the least avail, except an early and complete removal of the disease, and as this is almost impossible at the time that the case presents itself, owing to the fact that the infection of the lumbar lymphatic glands is so very rapid, it follows that castration is, as a rule, far too late.

The methods employed in removing the diseased gland are similar to those which have been mentioned when sarcoma of the testis was under discussion (p. 59).

CHAPTER V.

TORSION OF THE CORD OF AN IMPERFECTLY DESCENDED TESTIS.

Definition.—The axial rotation of the spermatic cord of a testis which has not reached its normal position in the scrotum.

Causation.—Torsion of the spermatic cords may occur either in connection with an imperfectly descended testis or with one that has gained its normal position in the scrotum. The condition, however, is undoubtedly more commonly associated with incomplete transition of the organ than otherwise.

It is still an uncertain matter as to what is to be considered the precise cause of the twisting of the cord, a lesion which may lead to such dire results to the gland that hangs from it.

Almost all the viscera within the abdomen that possess pedicles are at times the seat of axial rotation, and many tumours that form within the abdomen are also liable to have their pedicles twisted.

The chief factors that may be supposed to exert an influence on the torsion of the spermatic cord may be consequently divided into two classes—viz., the predisposing and the exciting.

Predisposing Causes of Torsion of the Spermatic Cord.

1. Imperfect descent of the testis.
2. Abnormally long mesorchium.
3. Practical absence of a mesorchium.

4. Action of the gubernaculum testis.
5. A congenital twist of the cord.
6. A roomy tunica vaginalis.
7. A flattened condition of an imperfectly descended testis.

That partial descent of the testis is a definite determining cause of torsion of the spermatic cord seems to be borne out by the fact that so large a number of the cases in which this condition has arisen have been in those who were the subjects of an imperfect transition of the organ.

Whether this liability to twisting is due to the actual arrest of the testis or is dependent upon some factor which is to be found in association with the arrest, it will be necessary to inquire further.

There are two important peculiarities that may be perceived in the testes which have not reached their rightful place at the bottom of the scrotum. These are : that there may be an abnormally long mesorchium, and that there may be two cords supporting the testis, the one consisting of the vessels and their accompanying structures, and the other of the vas deferens.

It is a further fact that, when the one state is present, the other is very commonly in existence as well.

The reason for this anatomical arrangement is not far to seek ; it is in the conditions that determine the development of the two integral parts of the testicle. The body of the testis has its own blood-supply, and these vessels lie in the plica vascularis, which will then form one cord, or part of the mesorchium, while the epididymis and the vas have an altogether different origin, and therefore a separate blood-supply, the vessels of which consequently tend to form in certain instances a distinct cord, which may become itself the site of torsion.

It thus comes about that the testis is less firmly tethered than it is in its normal condition, and there is the likelihood, should any exciting cause occur, for an axial rotation to take place.

On the other hand, the absence of any fold of peritoneum

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constituting a mesorchium may possibly leave the structures forming the cord in a less hampered state, and thus allow an exciting cause to bring about rotation.

It must, however, be a very rare condition for no trace of the mesorchium to be present, and unless it is practically absent it is difficult to see how it could act otherwise than as a deterrent, rather than a producer of torsion.

It is extremely doubtful whether the gubernaculum can have any influence on the causation of the twisting of the cord.

It has been suggested that, supposing there has been some degree of intra-uterine peritonitis which in itself has occasioned the arrest of the testis, the efforts of the gubernaculum, if such there be, may tend to an abnormal drag upon the adherent organ, and so lead to its supporting structure, the spermatic cord, undergoing a rotation.

This might be termed in some cases a congenital twist of the cord.

But even if a condition of this nature is ever present, it is unlikely that it would alone be sufficient to produce a marked torsion, such as would result in strangulation of the organ.

Absence or imperfect development of the middle band of the gubernaculum, probably to a considerable extent, affects the mobility of the testis, and this abnormality has been shown to exist with imperfect descent.

A roomy tunica vaginalis testis will give more space within which the actual rotation of the testis may occur. It must therefore be admitted that, although partial descent of the testis is related to the occurrence of a twisting of the cord, yet it is not by any means clear as to how the arrest tends to influence the onset of the torsion, unless it is that the imperfect transition is accompanied by a greater proportionate length of the mesorchium.

To sum up, the chief predisposing cause at work is partial descent with a freely movable testis.

Exciting Causes of Torsion of the Spermatic Cord.

1. Muscular effort.
2. A mechanical twist.
3. The action of the cremaster.
4. The application of a truss.
5. Attempts at the reduction of a hernia by taxis.
6. Approach of puberty.

Movements imparted to the testis and its cord, and that particularly to a testis that has only partially descended, may be occasioned by muscular effort.

This is peculiarly liable to be the case should there be inguinal inclusion of the organ. The testis is in this situation exposed to the action of the powerful oblique and transverse muscles of the abdominal wall. Severe muscular efforts, such as are produced by bicycling, boxing, jumping over a fence, mounting a horse, etc., have all been placed on record as a probable exciting cause of torsion, either in the case of an arrested or a fully descended testis.

A sudden fit of sneezing and other deep respiratory efforts, as coughing, cornet blowing, may also be exciting influences.

It is common among certain breeders of stock to emasculate animals by bringing about atrophy of the testes by twisting their cords, rather than by performing castration.

After such a procedure simple atrophy of the organ is the rule, of a nature similar to that which occasionally follows ligature of the spermatic veins for varicocele. Gangrene proper does not take place unless septic bacteria are in some manner introduced into contact with the congested tissues.

This mechanical twisting may be thoughtlessly brought about by a boy, especially when the organ is at all irritable, near the period of the onset of puberty.

It is possible that some of the atrophied testes which are discovered after manhood has been reached may have been caused by an inflammation of the gland set up by a partial twist of the cord induced by manipulation of the possessor.

It is feasible also that a smart blow upon a testis lying high in the scrotum or in the inguinal canal might produce

rotation. It is conceivable, moreover, that a sudden and irregular contraction of some of the more obliquely placed fibres of the cremaster muscle may have some effect in the causation of a twist. That the application of an ill-formed and improperly adjusted truss may occasion pressure upon an imperfectly descended testis, so as to primarily give rise to a rotation of the organ, is possible, but not altogether likely. The discomfort of the truss may lead the sufferer to try to obtain relief by himself handling the testis while the truss is still in position, and this might induce a twist in the cord. It is extremely doubtful whether a well-made and accurately adjusted truss would ever cause any disturbance of the natural position of the cord. As a rule, when a truss is applied to a case in which a hernia is present with an imperfectly descended testis, the organ readily slips out of the way of the truss, and is not, therefore, influenced by it.

Attempts to reduce a hernia when it has slipped down in front of an arrested testis, or the efforts made to return such an organ on the supposition that it is itself an irreducible hernial protrusion, have apparently led to the torsion of the cord. This is, in fact, a mechanical twisting, the incidence of which has been promoted by the necessity, fancied or real, for taxis.

At the approach of puberty, and possibly, also, in the turgescence of coitus, the vessels of the spermatic cord and those of the epididymis and the testis become over-full, and thus a condition is set up which may lead to a kind of erection of the parts, with a tendency for them to be more or less pushed thereby out of their normal and natural position. It is not unlikely, also, that increased activity of the cremasteric fibres, which is sometimes noticeable at such periods, may have a slight bearing upon the production of a rotation of the testis.

It is significant that many instances of torsion of the cord have occurred in boys and youths between the ages of fourteen and twenty, though cases have been recorded soon after birth and at the late age of sixty-two, the last, however, in a fully descended testis.

Signs and Symptoms.—In almost every case of a twist of the spermatic cord the onset has been a sudden one, and the signs and symptoms have followed very rapidly. Pain of a severe nature situated in the region of the testis, but also sometimes referred to the lumbar region, is always present.

Local tenderness is never absent. Nausea or actual vomiting may occur.

The patient soon becomes faint, breaks out into a cold perspiration, and exhibits much anxiety.

Constipation, though not absolute, is not infrequently in existence, but its presence may be purely accidental; although if noticed it has an important bearing upon the question of diagnosis.

The temperature is occasionally raised somewhat, especially should the lesion have been in evidence for some hours.

The pulse-rate is increased. Abdominal distension has been noticed.

The local signs are those produced by the swelling caused by the interference with the return of blood from the testicular tissues, by the effusion of fluid into the tunica vaginalis in many instances, and by the inflammatory action that is set up if the condition has been present more than a few hours. The swelling is hard, often tense, irreducible, dull on percussion, and without an expansile impulse on coughing.

Some redness and œdema of the skin of the affected area may supervene, and even sloughing has occurred.

When the testis hangs just below the superficial abdominal ring it is usually easy to make out the exact site of the torsion, and the marked difference there is between the turgid swollen portion below and the normal segment above.

Diagnosis.—The importance of the correct diagnosis of torsion of the spermatic cord lies in the fact that the condition so closely resembles that of a strangulated hernia.

Were it not for the mildness of the symptoms, as a rule, when they are compared with those that are present in connection with strangled gut, almost all cases might very fairly be thought to be those in which bowel was nipped.

When the affected testicle lies in the inguinal canal or

just below the superficial ring, the difficulty in accurately diagnosing the condition may be very great.

It should be noted, however, that the nausea and vomiting are never severe nor persistent, that the constipation, should it be present, is not absolute, that the abdominal distension is but slight, that pain is chiefly local, and that there is not the marked tenseness of a strangulated hernia. It is not at all unusual for a hernia to actually accompany an imperfectly descended testis, and it is therefore important to bear in mind the fact that both may be in existence in one and the same person, and that the hernia may indeed be the seat of strangulation.

There is often much uncertainty as to the true state of the parts, and it is in these cases that an exploratory operation should be urged in order to clear up the diagnosis and allow adequate treatment to be adopted.

Nothing can be lost by an early incision, and much may be gained. When the affected part has been laid bare by the scalpel, the diagnosis lies only between the strangled testis and the strangled gut. The solidity, denseness, and weight of the former usually serve to differentiate the testicle from the bowel. Occasionally strangulated omentum in a hernial sac causes signs and symptoms not at all unlike those that are apt to be present when the cord of a testis is twisted. Here, again, an incision will at once settle the question as to which lesion is in existence.

Among other conditions that may be mistaken for or confused with torsion of the spermatic cord are acute inflammation, either traumatic or gonorrhœal, of a testis that has not reached the lower limits of the scrotum, acute lymphadenitis of the inguinal glands, acute thrombosis of the veins constituting an inguinal varicocele, and, lastly, appendicitis associated with suppuration. The diagnosis of torsion of the cord, strangulated hernia, and lymph-adenitis from one another may be conveniently reviewed in tabular form.

DIFFERENTIAL DIAGNOSIS OF TORSION OF THE SPERMATIC CORD, STRANGULATED HERNIA, AND ACUTE LYMPHADENITIS.

	Torsion of Cord.	Strangulated Hernia.	Lymphadenitis.
History - - -	Probable of strain.	Often of strain.	Of infection.
Position of testis -	Often imperfectly descended.	Usually fully descended.	Usually fully descended.
Shock - - -	Moderate.	Often severe.	None.
Vomiting - -	Slight and not persistent.	Severe and persistent.	Occasionally nausea.
Constipation - -	May be present.	Is absolute.	None.
Tenseness - -	Not marked.	Marked.	Induration or fluctuation.
Impulse on cough -	May be expansile if hernia be present.	No expansile impulse.	No expansile impulse.
Condition of cord -	May be felt twisted.	Obscured.	Normal.

Morbid Anatomy.—As soon as the vessels of the spermatic cord undergo a rotation around their longitudinal axis, the circulation of blood within them is seriously interfered with.

The onset of the torsion more markedly affects the thinner-walled venous channels than the artery, with the result that, while the blood is pumped in through the latter, it cannot properly return through the former.

The consequence of this is a rapid and extreme turgescence of the veins of the pampiniform plexus and great congestion of the whole of the parts from which they derive their blood.

The actual changes in the testicular tissue which result from this disturbance of the circulation are not unlike those hæmorrhagic infarctions of the intestine caused by embolic obstruction of the mesenteric arteries. It is this over-full state of the vessels that leads to the agonizing pain from which the patient suffers. Soon the testis becomes greatly increased in size, often to twice, or even thrice, its normal magnitude. Occasionally it is only the epididymis that is enlarged, the body of the testis remaining almost its usual size. This is the result of a twisting of only that cord which carries the vessels of the epididymis and vas. If the congested testis is exposed by an incision, it will be found to

be bluish-black in colour, not unlike a ripe purple plum, and somewhat like very deeply congested gut. This discoloration may in some instances be visible even through the integuments.

A certain amount of fluid, usually blood-stained, may pass through the distended vessels into the cavity of the tunica vaginalis testis. Occasionally the vessels actually give way under the pressure to which they are subjected, and pure blood is thereby extravasated. It is interesting to note that there may be a comparatively early invasion of the congested tissues by bacteria, both cocci and bacilli, but possibly only in the cases in which an accompanying hernia has allowed intestine to lie in juxtaposition.

These micro-organisms may lead to suppuration in the sloughing organ or to the formation of pus in the wound, when an operation has been performed.

The bacteria thus present are apparently identical with, or very closely resemble, those which have been isolated from gangrenous intestine, the outcome of its strangulation in the human subject. Supposing, therefore, that the imperfectly descended testis, which has a coexistent hernia, becomes the site of torsion of the spermatic cord, more or less damage may also occur to the protruded intestine, either by pressure or manipulation used in the mistaken diagnosis of a strangulated hernia, with the result that bacteria, and particularly the colon bacillus, may penetrate the intestinal walls and reach the engorged testicular tissue. When septic gangrene supervenes gas is usually produced, which may cause some emphysema of the overlying tissues.

Prognosis.—For the integrity of the gland the prognosis is very grave. Even one attack of rotation, and that one only permitted to be in evidence quite a short period of time, say but a few hours, has been demonstrated to lead to atrophy of the testis. Repeated attacks unquestionably tend to eventual disorganization.

If an acute torsion is allowed to persist, sloughing of the testis is almost a certainty. Even after the strangulation has been relieved by the untwisting of the cord, the testicle may never recover its vitality.

PLATE XXIV.

FIG. 47.—STRANGULATION OF A TESTIS DUE TO TORSION OF ITS
CORD.

The darker patches indicate extravasation of blood into its substance.
(Guy's Hospital Museum, No. 2078.)
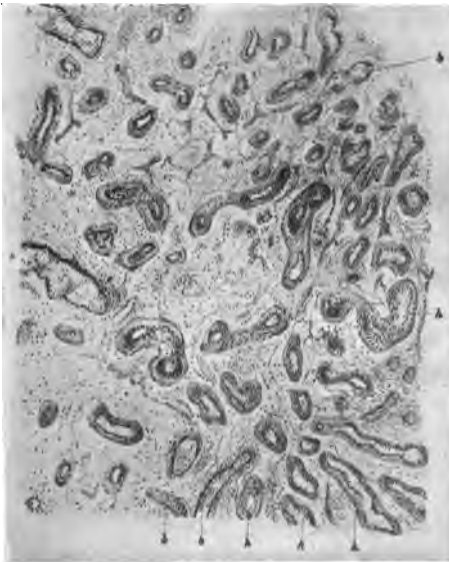
FIG. 48.—SECTION OF TESTIS, THE CORD OF WHICH HAS UNDER-
GONE TORSION, EXHIBITING EXTRAVASATION OF BLOOD INTO
ITS SUBSTANCE. (CAHEN, *Deut. Zeit. f. Chir.*, 1890, p. 101.)

Suppuration is liable to occur, and occasionally peritonitis may follow. As a rule, there is no other danger than the local damage, and after removal or sloughing of the testis the patient may make a rapid recovery.

Treatment.—If diagnosed in time the rational treatment of torsion of the cord would seem to be the untwisting of the twisted cord without any operative interference. This manœuvre can be carried out satisfactorily only in those instances in which the testis lies in its normal position at the bottom of the scrotum, and is hardly applicable to the cases in which the organ is retained in the inguinal canal.

Unfortunately, it is rare for an accurate diagnosis to be made in the early stages of the lesion, or before an exploratory operation has been undertaken, and thus it follows that the treatment in many instances resolves itself into the question as to what should be done with the testis when it has been exposed.

In most patients the actual condition that is present is not by any means clear, and it is, therefore, generally best that the swelling should be explored and the lesion thereby accurately determined. Taxis will only be productive of certain harm, even supposing that no hernia exists, and it would be of very doubtful value should a protrusion be present.

If a torsion of the cord is exposed after the first twenty-four hours of the onset of the affection it is useless to unravel it, for the testis is certain not to recover itself; for even if it should not slough, yet it will completely atrophy, and all the function that it originally possessed will be sacrificed.

It is imperative, therefore, that the testis should be removed together with as much of the spermatic cord as has shared in the damage occasioned by the torsion.

Care should be exercised during the castration to prevent, as far as possible, any contamination of the wound with the fluid that may be found in the tunica vaginalis, and which is likely to be septic in nature; further, the engorged surface of the testis itself should be prevented from coming in

contact with the raw tissues.   Drainage of the wound is advisable if there is any doubt as to its asepsis.

Any coexistent lesion, such as hernia, is to be dealt with at the same time, provided that there are no indications to the contrary.   In those instances in which the patient has repeated attacks of symptoms referable to probable torsion of the cord of an imperfectly descended testis, castration should be advised.

It will thus be seen that it is probably useless to attempt any other treatment for actual torsion of the cord, or what appears to be repeated attacks of the same, save that of the entire removal of the testis.

No untwisting of the cord and no drawing of the testis into the scrotum and fixing it there will have the slightest effect in preventing an untoward result.

It is convenient to notice at this point the condition known as a

Varicocele of the Cord of an Imperfectly Descended Testis.

It is but rare that varicosity of the pampiniform plexus of the cord of the imperfectly descended testis is present.

It may be found, however, in connection with the testis which, having failed to pass into the scrotum, has migrated into the perineum.   As has been seen in these cases, the testis is not by any means infrequently well developed, and its vessels are of normal calibre; and seeing that it occupies a position that is not very far remote, considering its level, from that of the testis within the scrotum, it is not unlikely that factors which ordinarily lead to the production of varicocele may act here also.

The condition would give rise to the well-known and characteristic swelling of a varicocele, only that the tumour would be present along the side of the perineum and close to the margin of the anus.

Probably the inconvenient place in which the dilated veins lie will lead to more discomfort than even the varicocele occurring in the cord of a naturally placed organ.   The only condition for which the enlarged vessels are at all likely

to be mistaken is an abscess in the perineum, their soft feel and the evident swelling giving rise to the error in diagnosis.

The fact, however, that there is no induration unless thrombosis has ensued, and no signs of acute inflammation, together with the absence of the testis from the corresponding side of the scrotum, all tend to make the diagnosis clear.

With regard to treatment, should the condition occur in a subject who is otherwise healthy, operation is indicated with a view to the cure of the varicocele by ligature, and the transplantation of the misplaced testicle into the scrotal tissues.

Should dilatation of the vessels of the cord of a testis lying in the inguinal canal occur, then castration is clearly indicated.

CHAPTER VI.

HERNIA IN RELATION TO IMPERFECT DESCENT OF THE TESTIS.

THE processus vaginalis of the imperfectly descended testis has a distinct bearing upon the transition and development of the gland, as well as having an association with the causation of a hernial protrusion.

When the testis is found to be undersized, but in the scrotum, it is usually found that the processus vaginalis has remained as a patent tube, and that abdominal viscera have prolapsed into it.

When the testis is arrested in the inguinal canal, it is also frequently but poorly developed, and the accompanying pouch of peritoneum fails to become shut off from the general cavity of the peritoneum. It does not, however, necessarily follow that this patency will lead to any subsequent ill-effects, but it obviously leaves the door open for the formation of a congenital hernia or hydrocele.

Inguinal inclusion more often means a patent process than does an arrest just below the superficial ring, and ectopia of the testis is probably more often associated with an open processus vaginalis than is a gland in its normal place in the scrotum.

Not infrequently the peritoneal pouch which is associated with a testis which has not fully migrated remains proportionately larger than the unobliterated pouch of the fully descended organ.

It is, perhaps, sometimes owing to this wideness of the tunica vaginalis testis that torsion of the spermatic cord of the arrested testis occurs.

The serous membrane forming the process is often of extreme thinness, so that its separation from the tissues becomes a matter of considerable difficulty.

Hernia in Association with Imperfect Descent of the Testis.

Hernia associated with imperfect descent of the testis may be either congenital or acquired, but the former variety is infinitely more common than the latter.

Congenital Inguinal Hernia is the protrusion that is most commonly associated with the arrest of the testis.

Frequency.—The frequency with which inguinal hernia accompanies imperfect descent of the testis is great, for probably hernia occurs in more than half the cases. The marked frequency of the lesion is easy of explanation.

It would appear that in the majority of cases of arrest of the testis there is an associated want of formation or of development of the annexa, which fact in itself may be one of the causes of the non-passage of the gland into its normal habitat.

Causation. — Thus it happens that though the tube of peritoneum, known as the processus vaginalis, spontaneously closes in great part when it has reached the bottom of the scrotum, together with a normally developed and migrated testis, yet when it remains behind with an arrested organ it maintains, as a rule, its patency and communication with the general cavity of the peritoneum, and thus affords every facility for the prolapse of viscera.

Moreover, also, in those instances in which there has been no diminution in the length of the outgrowth of parietal peritoneum, the processus vaginalis having passed into the scrotum well beyond the position of the arrested testis, or those in which it has accompanied the ectopic organ into its abnormal position, persistent patency is again usually in evidence.

Briefly, then, the processus vaginalis of the arrested or misplaced testis is more generally patent than is that of a testis that has arrived at the bottom of the scrotum.

It is this common patency of the tube of peritoneum

accompanying the imperfectly descended testis which is the primary predisposing factor in the production of the congenital inguinal hernia so frequently seen. Further, some amount of imperfect development of the musculature of the lower part of the abdominal wall in the inguinal region is again a definite predisposing cause of hernia, and this may be present in association with failure of the testis to reach the scrotum. But neither of these two factors are necessarily in themselves sufficient actually to determine the protrusion, but there is needed some exciting cause, such as is present in so many cases in which hernia is formed when the testis lies in its normal position.

The majority of cases of inguinal hernia associated with imperfect descent of the testis are in evidence early in life, and this fact suggests the probability that there are in infancy exciting causes at work. No less than 35·1 per cent. of herniæ with arrest of the testis occur in the first year of life, while in inguinal herniæ in persons who are not afflicted with imperfect descent of the testis only 7·7 per cent. commence before twelve months of age.

Inguinal and abdominal inclusion favour the early development of a hernial protrusion, while the testis, lying just below the superficial abdominal ring and high in the scrotum, does not usually so soon have a hernia accompanying it. But it must always be borne in mind that the subjects of partial descent of the testis may exhibit a hernia at any age.

The exciting causes that tend to induce the onset of the hernia in early life are disease of the lungs, over-distension of the abdomen by inflation of the intestines with gas the outcome of enteritis, possibly phimosis, and some other less common conditions.

The very fact of the presence of the testis in the inguinal canal may tend to prevent the arching fibres of the internal oblique and transversalis muscles from acting as they should in the way of a sphincter.   It is this action which closes the oblique canal in the inguinal region, completely obliterating it for the time being, when it contains only the normal cord of a fully descended testis.

If, however, the gland has been arrested in this space, then the processus vaginalis will not be completely closed, and permanent obliteration of its cavity will not occur.

Sometimes a hernia is developed on the side opposite to the arrested gland, but even in such cases the fact that the genital gland has not reached its normal position may indicate some congenital want of proper development in the inguinal region, even although the testis had fully passed into the scrotum on the opposite side.

Still, the evidence remains that all cases of imperfect descent of the testis do not develop hernia, though a large proportion do so, and that some cases of imperfect descent develop a hernia on the side which is opposite to that on which the testis is arrested.

Position of the Arrested Testis associated with Hernia.

The position in which the testis is arrested should, it would seem, play an important part in the frequency with which a hernia is developed, but it is somewhat difficult to give figures which are conclusive on this point.

Out of 936 instances of imperfect descent with hernia, 334 testes were found to be in the inguinal canal, 254 just below the superficial abdominal ring, 171 hanging high in the scrotum, 139 retained within the abdomen, 17 in the cruro-scrotal pouch, 6 in Scarpa's triangle, and 5 in the perineum.

It must, of course, be remembered in connection with these figures that inguinal inclusion is the most usual form of imperfect descent, and therefore the larger number of cases of associated hernia is necessarily found in this class. It will be noticed that in 254 cases the testes lay just below the superficial ring, having transgressed the limits of the canal. In some of these instances it is undoubtedly true that when the hernia first made its appearance the testis occupied a higher level than it did when the case presented itself for treatment. But the number of cases in which the arrested testis has its position altered, either by active further transition or by passive forced descent, is small.

A person with an arrested testis may present no hernia at all; he may have a further descent of the testis coincident with the onset of a hernia, or the hernia may occur at an earlier period than the further descent. It is not common for a hernial protrusion in its incidence to promote further descent, but there is a distinct influence exerted by the presence of a well-marked hernia upon the position of the testis. Perhaps this is best seen in certain instances of interstitial herniæ.

The Side on which the Arrested Testis is associated with a Hernial Protrusion.

In 467 instances the right testis alone was imperfectly descended, in 265 the left, and in 102 both. It will thus be observed that incomplete descent with hernia occurs most frequently on the right side, but that this only corresponds with the greater frequency with which the anomaly of the testis is found on the right side.

Forms of Inguinal Hernia associated with Imperfect Descent of the Testis.

The chief varieties of inguinal hernia that are associated with imperfect descent of the testis are :

1. Bubonocele.
2. Scrotal.
3. Interstitial.
4. Cruro-scrotal.
5. Superficial perineal.
6. Femoral hernia.

Any one of these may be either reducible, irreducible or strangulated.

1. Bubonocele in Association with Imperfect Descent of the Testis.

As would be naturally expected, a bubonocele is the most frequent form of inguinal hernia met with in association with imperfect descent of the testis. It is, moreover, the commencement of several of the other varieties, and these,

PLATE XXV.

FIG. 49.—A LEFT TESTIS IN ABDOMEN, ACCOMPANIED BY A
BUBONOCELE.

FIG. 50.—A BUBONOCELE IN CONNECTION WITH IMPERFECT DESCENT
OF THE RIGHT TESTIS.

a, Aponeurosis of the external oblique; *b*, site of superficial ring; *c*, site
of deep ring; *d*, testis in canal; *e*, knuckle of bowel; *f*, anterior
superior spine; *g*, crest of ilium; *h*, lowest portion of processus
vaginalis. (St. Bartholomew's Hospital Museum, No. 2136.)

PLATE XXVI.

FIG. 51. — A RIGHT TESTIS JUST BELOW THE SUPERFICIAL ABDOMINAL RING, ACCOMPANIED BY A BUBONOCELE.

The right half of the scrotum is developed, but not distended.

if they had been seen in their early stages and their subsequent development stayed, would have remained as bubonoceles.

With the non-closure of the processus vaginalis testis, nothing is more likely to happen when the testis is lying in the inguinal canal than for some of the abdominal viscera to prolapse into the waiting sac.

The same may happen even when the testis is completely retained within the abdomen, provided that a peritoneal pouch has entered the canal and has remained patent.

ANATOMY OF A BUBONOCELE.—When an inguinal hernia does not pass beyond the confines of the inguinal canal, it is covered with the following layers: Skin, two layers of superficial fascia, the aponeurosis of the external oblique muscle, some amount of cremasteric fascia and muscle, and the transversalis fascia, under the designation of 'infundibuliform fascia' or 'internal spermatic fascia.' The coverings may in certain instances be extremely thin, particularly in those cases in which there has been a want of proper formation or development in the musculature of the region, which is not infrequently an accompaniment of arrest of the testis.

As a rule the testis can be made out, its exact position in the canal varying. Sometimes the contents of the sac will obscure the presence of the gland; but if these be retained within the abdomen, then the organ may be palpated, to be found in most instances much below its normal size, and now and then very sensitive.

The deep ring, the potential opening in the transversalis fascia, through which the organ, when it has left the abdomen and entered the canal, has passed, is small, and therefore strangulation of intestine in it, should it occur, is apt to be very acute. There is generally an intimate relationship between the back of the peritoneal pouch and the short spermatic cord, and their separation the one from the other may be a matter of some difficulty in a radical operation upon the hernia.

When the testis has remained behind in the abdomen, and a peritoneal pouch has descended into the canal,

6

it occasionally happens that the vas deferens, or even the epididymis, have also passed into the passage, and may be felt as cords lying posterior to the hernial sac.   As a general condition, the processus vaginalis is wholly patent throughout the canal, and in such a state the hernial contents will reach as far and even possibly beyond the site of the testis.

In some of these cases there will be found adhesions between the contents of the sac and the upper portion of the testis, thus rendering the hernia an irreducible one. In yet other cases there may be found that some obliteration of the process has occurred in its lower part, thus shutting off the hernial sac from the testis itself.   These forms of hernia are very uncommonly irreducible.   Still more rarely, an encysted hernia, so called, may be present.   In these there has been a closure of the process of peritoneum at the site of the deep ring, and the septum so produced has at a later time been pushed down by the advance of viscera into the unobliterated tunica vaginalis testis below.   Thus a sac lies within a sac.

SIGNS AND SYMPTOMS OF A BUBONOCELE—*Reducible.*— Frequently there is a history of the patient, or the patient's friends, having been aware that he had a swelling in the groin, and that this tumour had more recently increased in size when he was in the upright position or on coughing, but that it disappeared, as a rule, when he assumed the horizontal position.

Such a statement would imply that the arrested testis had formed the primary swelling, and that the superadded hernia, in the form of a bubonocele, had caused the increase in bulk. On the other hand, the hernia may itself be the first tumour to be observed when the testis is intra-abdominal.   When the parts are palpated, on asking the sufferer to cough, a definitely expansile impulse will be obtained, and the same will be felt in an infant during crying.

Further, it will be found that the swelling is generally wholly reducible, and that the contents of the sac return into the abdomen either with a characteristic gurgle of intestine, or with the feeling as if a solid body was slipping away from the fingers, or with both of these signs.   When

the contents have been reduced, then the arrested testis, supposing it to be in the canal, will usually be felt, and give its peculiar sensation when compressed.

Irreducible.—A simple irreducible bubonocele will form a swelling in the inguinal region, part of the contents of which is reducible, while another portion does not return to the abdomen, either spontaneously or on the employment of taxis.

This want of complete reducibility is generally the outcome of adhesions between the contents of the sac and the imperfectly descended testis. Adhesions of this nature may be either congenital or acquired, and may be very thick or quite slender.

The hernial protrusion will still give evidence of a marked expansile impulse on coughing or crying, and if part is reducible, then the same signs caused by that quality will be present, as they are in the fully reducible swelling. In both the reducible and the irreducible herniæ, pain, local or referred to the umbilicus or back, will be experienced by the patient.

Strangulated.—This clinical variety of bubonocele will be dealt with later.

DIAGNOSIS OF A BUBONOCELE.—A bubonocele in association with an arrested testis requires to be distinguished from mere retention of the testis, from a hydrocele accompanying an arrested testis, and from tumours of the imperfectly descended organ.

When the contents of the sac are wholly reducible there is not much difficulty in deciding the question, but when a part or the whole of the viscera will not return into the abdomen, then some confusion may occur.

It must be remembered, in the first place, that a retained testis itself may present a very tangible swelling when placed in the inguinal canal. Moreover, with a hydrocele around it, or a growth in its substance, it may certainly have an impulse on coughing, but this will be of the nature of a simple forward movement, and not of a true expansile character. It is important, therefore, to very carefully examine for the valuable sign of actual increase in size of the tumour on any expiratory effort.

6—2

When liquid and not intestine or omentum surrounds the testis, the swelling will generally have a tenser feel, and will be uniform on its surface and in its consistency.

A new growth will have the history of a steady progressive enlargement without any fluctuations in the size of the swelling. Testicular sensation, as a rule, will be lost, and the swelling is firm to the touch. It is impossible to determine the exact form of bubonocele that may be present without an exposure of the parts by dissection.

PROGNOSIS OF A BUBONOCELE.—Unless treated, a bubonocele will advance until it reaches a considerable size, and becomes a scrotal or other larger variety of hernia.

Owing to the comparative narrowness of the aperture through which the hernia protrudes and the space into which it descends, there is a very grave danger of an extremely acute strangulation occurring.

Since the testis, if in the canal, bars the way for closure of the processus vaginalis, there is but little, if any, chance of the hernia becoming spontaneously cured, and it is liable, unless treated by operative means, to remain a lifelong burden to the sufferer.

TREATMENT OF A REDUCIBLE BUBONOCELE.—The treatment of a reducible bubonocele associated with imperfect descent of the testis is either palliative—that is, mechanical —or operative. Every case requires to be taken on its own merits, and the treatment must be prompt and decisive, for delay or indecision will inevitably lead to serious results.

Palliative Treatment of a Reducible Bubonocele. — This resolves itself into the reduction of the contents of the hernial sac, and the application of a truss to keep them reduced, together with the removal of any exciting causes of the protrusion.

Conditions under which Palliative Treatment should be carried out.—There are certain conditions in which a bubonocele accompanying an imperfectly descended testis should not be submitted to operation, but should have only palliative treatment accorded to it.

Among these are early age, pulmonary or other visceral disease, particularly gastro-enteritis, grave associated bodily

deformities, as ectopia vesicæ, ill-development of the abdo‧ minal muscles, etc.

In the first few months of infancy a child does not bear operative procedures too well, and there is some risk of septic infection of a wound if such be made. Further, there is always the possibility, or even the probability, that the testis that has failed to reach the scrotum before birth may yet descend thither, and this specially so in infants born before full term. Thus operation is not really necessary in such in order to aid the testis in gaining its proper position, and therefore, if the hernia can be successfully dealt with by means other than operative, it may be best to defer such interference even if it is not thereby avoided altogether.

Pulmonary disease is always a strong contra-indication to operative measures, on account of the fact that the coexistent and persistent cough is very liable to produce a return of the hernia after operation, and this in a worse form than it was originally.

Gastro-enteritis, usually the outcome of improper feeding in the early months of life, causes an accumulation of flatus in the intestines, and this distension of the bowel and the consequent increased intra-abdominal pressure militates seriously against a permanent cure. When it has been decided that the case is one that should be treated by a truss, the questions of primary importance which at once arise are whether any harm will ensue to the arrested testis by the presence of the instrument, and whether the application of the same will in any way hinder the possible further descent of the gland.

The position in which the testis is placed has a considerable bearing upon the answer given to these queries.

Treatment of Hernia with the Testis in the Abdomen.

When the testis is completely retained within the abdomen and has no tendency, even on expulsive efforts, to leave that cavity, then the adjustment of a truss to prevent any descent of other viscera into the patent processus vaginalis can in no way produce harm to the testis directly, although it may

tend to effectually prevent its migration into the canal and scrotum.

But in connection with this it is to be remembered that a radical operation performed upon the hernia must, in the great majority of instances, lead to a precisely similar result so far as the testis is concerned, for it is seldom possible to transplant an abdominal organ.

As has elsewhere been remarked, it is probable that a testis which lies wholly within the abdominal cavity and never attempts to leave it in order to descend into the inguinal canal is better placed, so far as development is concerned, than is a testis which has been arrested in the canal, or even just below the superficial ring. A truss, then, applied in such a case will be a rational and an effectual treatment, provided that operation is contra-indicated, and this is equally true whether one or both of the testes are so retained.

There are some very important points in connection with the form of truss to be ordered, and in the adjustment of the same to the patient.

For an infant nothing answers so well as a truss with the pad fixed to a steel spring which is more than a semicircle, and covered with pure indiarubber in such a manner that no join or seam will come in contact with the tender skin of the child.

The under-strap of lint, starting from the shoulder of the truss, should always be used, and changed as often as cleanliness requires.

A skein of wool truss is a false security, besides being incapable of exerting that amount of pressure over the canal which is certainly an aid in the closure of the processus vaginalis. Further, it is quite as liable as the spring truss, or even more so, to produce excoriation, and, on account of its having to be so frequently renewed, it in the end becomes just as expensive as the more elaborate instrument.

A measurement for the truss should be taken so that the tape lies in the plane of the brim of the true pelvis—that is, at the base of the sacrum behind, halfway between the crest of the ilium and the top of the trochanter at the sides, just

below the anterior superior spinous processus of the ilium, and above the symphysis pubis in front.

In the infant the level of the symphysis is often clearly marked by a cutaneous crease that lies curving across the lower part of the abdominal wall, and therefore its level is higher than it is often thought to be. The exact measure obtained should be taken as indicating the size required for a single truss, but should a double one be necessary it is, as a rule, well to add one inch to the actual measurement, seeing that there is nothing in the almost complete circle of metal in the instrument to allow of any stretching.

The adjustment of the truss is of the greatest moment.

The whole of the pad of the truss must rest upon the soft tissues of the abdominal wall—that is to say, it should cover the inguinal canal, and should not lie below the level of the symphysis pubis, or Poupart's ligament.

When, as is often the case, the truss is improperly adjusted at too low a level, the soft tissues overlying the front of the body of the os pubis must be compressed against the bone by the pad, and, being thus nipped, much discomfort will arise, and excoriation, and even ulceration, will ensue.

Further, such an application will fail to effectually retain the hernia, since the pressure will not be over the point of exit of the protrusion. On the other hand, a correctly placed pad will only bear upon soft parts that have no bony structure behind them, and will cause no bruising, and but rarely produce excoriation.

The pad is to be adjusted at the level of the transverse crease above alluded to, and on no account at a lower level, and the mother or nurse must be instructed in the proper maintenance of this position.

The under-strap is rightly placed at or just behind the shoulder of the truss, and tends to draw the spring away from the crest of the ilium and to tilt the lower edge of the pad a little upwards and backwards. In the infant and the young boy the truss ought to be worn at all times, day and night, sleeping and waking, save that it has to be removed for the purpose of cleanliness, and even then, when the hernial aperture is left unguarded by the pad, the mother

or nurse should protect it by placing the thumb over the region of the canal.

Even although there should be marked evidence of the apparent disappearance of the hernia at an earlier age, the patient should wear the truss until he is at least three years of age.

For an older child, or for an adult, a leather-covered spring truss, well fashioned and measured for in a manner similar to that above described, should be ordered.

The adjustment of the instrument in the adult is very much the same as in the child, and it is a good rule to follow to place the truss so that it rests high up behind, high up in front, and well drawn down at the sides.

A permanent cure as the outcome of truss pressure is probably not so usual in the case of a hernia with a testis arrested within the abdomen of an infant as it is in those in whom the testis is normally situated.

Treatment of Hernia with Testis in the Inguinal Canal.

When the testis has passed outside the confines of the abdomen and has reached the inguinal canal, the application of a truss for an associated hernia requires some further consideration than when the testis is completely retained within the abdomen.

In the canal the testis may be fixed or mobile.

When fixed, or only slightly movable, the pad of the truss adjusted over the canal, as it should be in order to retain the protrusion, must of necessity press upon the testis.   The question then arises whether such pressure will cause any harm to the organ.

Inflammatory attacks, the onset of a hydrocele, atrophy, or at least want of development, torsion of the cord, and innocent or malignant growths in the gland, have all been stated to have been due to the direct effects of truss pressure. It must be confessed that, while there appears to be some, there is but little conclusive evidence that a truss has in reality been guilty of occasioning any of the above-mentioned lesions.   Inflammatory attacks are probably the most likely

lesion to be induced, but even these are rare. If, however, inflammation does supervene in the arrested and fixed testis, there can be no doubt that it is a most serious matter so far as any further development of the testis is concerned, but it is extremely doubtful if any other untoward effect is produced thereby.

When an inguinal testis, in addition to being fixed, is hypersensitive, the pressure of a truss will probably be unendurable, and then removal of the organ, or its possible transplantation, together with a radical operation upon the hernial protrusion, is indicated.

It is in such cases as these—a testis lying in the inguinal canal and incapable of shifting its position—that the application of a horseshoe-pad may be of some service, so that the hernia may be retained while no direct pressure is brought to bear upon the testis. But even here such a form of instrument is inadmissible should the testis be quite at the upper part of the canal, for in that case the testis is certain to receive the pressure it is desired to avoid. In fact, a horseshoe-pad not infrequently actually causes the injury that it is planned to obviate.

On the other hand, when a testis, placed high up in the canal and accompanied by a hernia, is mobile, it may be displaced by the application of a truss in several directions. If lying high up in the canal just below the deep ring, then the adjustment of the pad of a truss may cause the testis to slip back again into the abdomen and to be retained therein.

A testis which is in the habit of passing in through the deep ring and afterwards out again into the canal is one that is peculiarly liable to become the seat of inflammation, the outcome of its being nipped during its excursions. For such a testis to be kept entirely within the abdomen is, perhaps, the best fate that can overtake it, and therefore the application of a truss for this purpose is correct. It is unlikely that the vessels of the organ in the cord are long enough to allow of its being readily brought down so far as the scrotum, and it is of little use to fix it in the canal. If the testis happen to lie at the lower part of the canal, then there is

a likelihood of the organ being at times pressed through the superficial ring by the pad of the truss lying above it. Once it has been forced outside, it may have its cord nipped, and it may find it difficult, or even impossible, to recover its former position in the canal. Such an accident is very painful, and one, therefore, that must be considered as indicating that the pressure of a truss is at times harmful.

But supposing that the mobile testis occupies the middle of the canal, as it so commonly does, it may by the pad of the truss become displaced upwards, or in some cases even downwards. As a general rule, such displacements cause no inconvenience, or if they do it is but slight.

The testis may in these cases assuredly be allowed to take care of itself, provided that operative treatment is out of the question. Furthermore, there are many instances in which a truss has been applied directly over a testis lying in the canal, has produced pressure upon it without displacement, and has prevented the descent of the viscera, yet without any trace of ill-effects to the organ or inconvenience to its possessor. When the arrested testis lies just below the superficial ring, the application of a truss to retain a bubonocele lying in the canal above it will in no way inter-fere with the testis, seeing that the gland is below the level of the symphysis pubis, and the pad of the truss should be altogether above the same level.

If the truss, on the other hand, is improperly adjusted so as to lie at too low a level, then the arrested testis is apt to suffer severely, as it will be nipped between the pad and the front of the body of the os pubis. With ectopic testis the hernia is, as a rule, more than a simple bubonocele.

Truss pressure in the treatment of a bubonocele associated with an imperfectly descended testis should be combined with certain additional lines of treatment, all of which tend to greatly aid in a favourable result and to an ultimate cure of the protrusion. The one of primary importance in the infant is undoubtedly a proper diet. Nothing leads so much to the effective control of the viscera within the abdomen as freedom of the intestines from distension with flatus.

The drum-like condition of the abdomen in improperly

fed infants is an active factor in the production of hernia, both inguinal and umbilical. It is astonishing how rapid will be the disappearance of the prolapse of the bowel when the intestines return to their normal condition after an infant has been placed on a rational diet.

Phimosis should be corrected by circumcision, as a really tight prepuce in which there is a definite obstruction to the outflow of urine may be an exciting cause of a hernial protrusion. The error, however, must be avoided of considering that the removal of the foreskin alone will of itself cure the hernia. Circumcision should certainly be carried out, but further direct treatment of the hernia must always accompany it, whether in the form of truss pressure or radical operation.

Development of the muscular system, and particularly of the muscles of the abdominal wall, is very advantageous as an adjunct in the treatment of congenital hernia. In older children and in adults it may be brought about by the judicious employment of special exercises, so planned as to bring into action the muscles it is desired to develop. The same line of treatment is to be advocated after the performance of a radical operation.

TREATMENT OF AN IRREDUCIBLE BUBONOCELE.—Simple irreducibility is not a common condition in a bubonocele at any time, but it is perhaps rather more frequently met with in those cases in which there is an arrested testis than when that organ has reached its normal place in the scrotum. As a rule, such a condition indicates that an operation should be advised and performed. If this should for some reason be out of the question, then the application of a hollow pad inguinal truss is necessary.

Operative Treatment of a Bubonocele associated with Imperfect Descent of a Testis.—Operative treatment of a bubonocele associated with an imperfectly descended testis is desirable where there is no contra-indication to it.

It is clearly the course to be adopted in most cases of simple irreducibility and of strangulation. The operation, as performed upon a reducible bubonocele, partakes of the nature of a radical one, and has for its object the obliteration

of the sac, the treatment of the arrested testis, and the closure, so far as it is possible, of the aperture through which the hernia descends, and thus of its cure.

The operation should not be undertaken in early infancy, but should be urged when truss pressure has failed to bring about an obvious cure, has produced great discomfort by interfering with the well-being of the arrested testis, when the sufferer is incapacitated by the hernia or by the imperfectly descended organ from carrying out the ordinary duties of his avocation, and when strangulation has been or is in evidence.

For the operation, save in strangulation, when it will have to be performed as an emergency, the patient should be prepared as for any abdominal operation. Thorough asepsis is imperative for a successful result. After anæsthetization, an incision is to be made over the line of the inguinal canal, the length of the incision varying with the age, size, and fatness of the patient. The skin and two layers of superficial fascia having been divided, the aponeurosis of the external oblique muscle is exposed. The fibres of this are to be separated in the line and the length of the superficial incision, and the interior of the canal, with its contents, laid bare.

When there is an abdominal inclusion of the testis, then the contents of the canal will most commonly be merely the processus vaginalis, which has descended into it and there become the site of a congenital hernia.

In a few cases, however, the vas deferens or the epididymis will also lie in the canal, and should be handled carefully. When there is an inguinal inclusion, then the testis and its cord will, in addition to the processus vaginalis, occupy the space of the canal. When the testis lies just below the superficial ring, then only its cord and the processus vaginalis will be found in the canal.

The surface of the peritoneal pouch being fully exposed, it should be incised with caution, and any contents of the sac reduced, and the condition of the testis, if it is lying in the canal, ascertained. Supposing that the position of the testis is intra-abdominal, and neither the vas nor the epididymis

have descended into the canal, the treatment of the sac is simple.

All that is required is to dissect it from its bed as far as the site of the deep ring, to transfix it there with sterilized silk, to ligature it, and to cut off the distal portion. It is not wise to practise any twisting of the sac, as there is a decided danger in these cases of the bladder not being very far off, and it might be drawn into the ligature.

It may be advisable before the sac is ligatured to determine with the finger the position of the retained testis, for should it be lying near the inner surface of the deep abdominal ring, and is sufficiently free, it might with comparative ease be brought down into the scrotum. This will be a rare possibility, but it is occasionally feasible, and the result may be in every way satisfactory. If the vas is in the canal such a manipulation may perhaps be more readily carried out, but it is very seldom that it can be thoroughly accomplished.

No attempt should be made to excise the abdominal testis ; it should be merely left where it is in the majority of instances. The testis so placed serves its part in the economy, and the fear that it will become the seat of inflammation or of malignant disease is very remote, and need scarcely be entertained. .

If there have been any symptoms of previous trouble with it, probably on account of it having been more fixed than usual, it may be freed and allowed to go untethered among the intestines.   •

Supposing the testis to be intra-abdominal, and the vas, or even the epididymis, to be in the canal, then either one or both of the structures are to be carefully dissected off the sac and returned within the abdomen if the testis is to be left there, before the sac is ligatured and cut off. Any damage done to these ducts will inevitably lead to the atrophy of the retained gland.

When the testis is actually in the canal, and especially when it is fixed there, then the procedure becomes more difficult.

After the reduction of any of the contents of the sac, and this may require either the separation or the ligature and

division of the adhesions, the condition of the arrested testis is to be examined.

If there is marked evidence that the gland is hopelessly ill-developed or completely atrophied, or so changed by inflammatory attacks as to have lost all its natural feel and to have become densely hard to the touch, and particularly when the patient has a well-developed and fully descended testis on the opposite side, then there can be no question that the correct procedure is to remove the useless organ. The excision, moreover, will considerably aid in the thorough closure of the hernial aperture.

When, however, the testis is fairly normal with regard to size and feel it should be preserved. In which case there are two courses open to the operator : one is to transplant the testis into the scrotum, the other to return it within the abdomen.

The methods of transplantation have been already discussed.

With regard to the replacement of the testis within the abdomen, there are some objections to the measure and some points in its favour.

Against the return of the testis might be urged the following facts : It has been shown, at any rate in certain animals —the dog, for instance—that a testis which is replaced within the abdomen before it has reached its full development never completes its growth, but tends to become atrophied.

Also that a fully developed testis so returned will inevitably diminish in size, and thus, degenerating, become presumably functionless, so far as spermatogenesis is concerned.

But to counterbalance this statement it must be remembered that an arrested testis in the greater number of cases is one which will not fully develop, even if it is placed under the most favourable of circumstances. Its replacement, therefore, within the abdominal cavity cannot alter its character to any prejudicial extent. Then it is advanced against the return of the testis that a testis so replaced within the abdomen, should it become the seat of inflammatory mischief, may give rise to a serious amount of trouble, and possibly lead to a fatal termination by setting up peritonitis.

Further, a malignant new growth may arise in the intra-abdominal testis, which will then have its earlier signs masked, and will necessitate a laparotomy for its removal.

If inflammation or malignant disease of the completely retained testis was really at all common, then this objection might hold good ; but either condition is a rare one, and it should not seriously influence the operator against the replacement of the organ if he considers that other points are in favour of so dealing with it.

An argument for the return of the gland within the abdomen is the fact that a testis, even though a poorly developed one, has some function in the economy, and therefore its preservation is a matter of importance, and that all the more so should the testis on the opposite side be also an ill-developed one.

Possibly, also, it may be a matter of some gratification to an adult patient to be informed that the removal of the testis is not necessary, although, in order to further the probability of the cure of the hernia, the gland will have to be replaced in the position from which it originally came. Also he may be assured that there it will be of some use to him, even although its powers as a generative gland will not be advanced.

And, lastly, in favour of its return, it is quite uncommon to find evidence in the after-history of cases in whom the testis has been replaced that the organ has given rise to any trouble, so that practical experience of this method of dealing with it is not unfavourable.

When it has been determined that the testis shall be sacrificed, its removal must be carefully carried out. This is best accomplished by the free dissection of the processus vaginalis and spermatic cord from the surrounding tissues, and up to the site of the deep ring. The testis will now be hanging freely from its cord, together with the portion of peritoneum constituting the processus vaginalis testis. The cord and process are then transfixed and tied with aseptic silk, and the stump cut through and allowed to retract within the abdomen.

Should it be decided, however, that the testis is to be · returned within the abdomen, then it is necessary to free the

organ completely from its accompanying peritoneum, and, dividing this at the region of the deep ring from the parietal peritoneum, to remove the sac as a whole, and then to return the testis with its short piece of cord into the extraperitoneal tissue of the iliac fossa.

Considerable caution must be exercised in the separation of the testis and its cord from the processus vaginalis testis in order that no harm may be done to the tender structures of the gland and its suspensory apparatus.

Whether the testis is removed or retained within the abdomen, the time has now come for the closure of the aperture through which the hernia has descended.

As has been pointed out, this is a much more simple matter when there is no necessity to consider the cord of a testis that has been brought down. Sutures of sterile silk are passed through the margin of the internal oblique and transversalis muscles and then through the deep aspect of Poupart's ligament.

In many cases there has been much dilatation of the canal, and these two points will be greatly separated from one another, so that there may be some disadvantageous strain upon the sutures. As a rule, not more than four will be required.

When the testis has been transplanted the same sutures are to be passed, but caution must be exercised so as to prevent any possibility of damage being done to the under-lying cord. Some operators prefer to bring the freed cord out in the front of the fibres of the internal oblique, so as to make them lie in the space between the muscle and the posterior surface of the aponeurosis of the external oblique.

When the canal has been closed or refashioned, then the superficial fascia and the skin are brought together by inter-rupted sutures of silkworm-gut, and no drainage, as a rule, employed, and the parts covered with gauze and collodion dressing.

This is left in place, unless any untoward symptom arise, until the end of the first week, when it is removed and the superficial sutures taken out. The patient should be kept in the recumbent position for a fortnight, at the end of which

time he may be allowed to get up, and, if an adult, resume his duties at the end of another fourteen days.

Unless there is a marked want of development in the musculature of the abdominal wall in the region of the hernia, it is not necessary to advise that a truss be worn after the operation, but should there have been a decided gap, or should it be thought that there was much strain upon the sutures when they were tied, it is well that a light instrument should be applied for a year or so.

Muscular development by aid of appropriate exercises is strongly indicated.

Strangulated Bubonocele : Frequency.—While strangulation of an incomplete congenital hernia with the testis in the scrotum is fairly frequent, strangulation of a bubonocele associated with an arrested testis is decidedly common. Probably this frequency can be partially explained by the fact that the swelling in the inguinal region is diagnosed, and that rightly so, as an imperfectly descended testis, but the accompanying hernia is overlooked. As a consequence of this no truss is ordered, and then without warning the bowel descends and is nipped. Such a condition is commonly seen in children and young adults.

Causation.—It is owing to the smallness of the aperture constituting the deep ring and to the narrowness of the canal that strangulation of the protruded intestine is apt to occur.

In addition, there may be adhesions under which the gut may slip and become nipped, and, lastly, the very presence of the testis in the canal leaves but little room for any intestine that may be forced down into it.

Signs and Symptoms.—A history of a sudden onset of distressing symptoms is very suggestive of strangulation.

In addition to the usual signs and symptoms of intestinal obstruction, persistent vomiting, absolute constipation, shock, etc., there may be a swelling in the groin, which, if it had been previously noticed, will now be found to have increased in size, and that rapidly.

It is to be borne in mind, however, that the local tumour may be very small indeed—in fact, so insignificant as to be overlooked unless great care is exercised in its detection.

7

The swelling may be irregular in shape, more elastic than usual on account of the presence of bowel, or doughy from the presence of omentum.   Local tenderness, especially where it has arisen very quickly, is an important symptom and very indicative of strangulation.

Diagnosis.—There are several other lesions associated with an arrested testis which may be mistaken for strangulation of bowel in a coexistent bubonocele—acute inflammation or strangulation of the testis itself, torsion of its cord, or the presence of lymphatic adenitis.

Acute inflammation of an arrested testis has many symptoms that are like those which occur when strangulation of bowel is present, and the chief points in the differential diagnosis have been already given on p. 23.

Strangulation of a testis may occur when the organ originally retained within the abdomen is forced out through the deep ring into the canal and is nipped by the structures forming the aperture.   An instance of this lesion may so closely resemble a strangulated hernia that the mistake is not discovered until the parts are exposed by an incision.

Not infrequently torsion of the cord of an arrested testicle has been mistaken for strangulated gut, and the two conditions resemble one another very closely.   The diagnosis has been fully discussed on p. 69.   Acute lymphadenitis associated with imperfectly descended testis is another condition that may be difficult to distinguish from strangulation of the intestine.   A cause for inflammation is, however, usually obvious, and this should greatly aid in the determination of the lesion.

It is not of much consequence should one of the above complications be taken for a strangulated hernia, but it may be a matter of great moment and peril to the patient if strangulation is diagnosed as one of them, and operative treatment, on account of the error, delayed until it is too late to be of service to the sufferer.

Prognosis.—Strangulation in a bubonocele associated with an imperfectly descended testis is a very grave lesion.   The nipping of the bowel is apt to be very severe, and its vitality

is put in much jeopardy. Many of the recorded cases have ended fatally, often because at the time of the operation the gut was found to be already gangrenous.

Treatment.—There is no doubt that the sooner the patient is submitted to operation the better. Nothing can be gained by waiting, and much may be lost by delay. Operation will reveal the exact state of affairs, will enable the operator to deal with the intestine and other hernial contents in the manner that their condition requires, and will allow of a radical operation being performed upon the protrusion.

On the other hand, taxis may be ineffectual, will tend to bruise or otherwise damage the intestine, will not remove the liability to recurrent attacks of strangulation, and may return the bowel that will not recover.

Gangrene so rapidly ensues on account of the very acute strangulation that it is imperative that the intestine should be released with the least possible delay, and that with as little damage to the coats of the bowel as can be.

The parts should be cleansed as thoroughly as the emergency will allow.

An incision should be made over the tumour, and after the sac has been exposed by the division of the aponeurosis of the external oblique muscle the tissues are to be protected by antiseptic swabs of gauze before the sac is actually incised, so that the fluid which may escape shall not come in contact with the wound, for it is liable to be septic. Great care must be exercised in the division of the wall of the sac, since the contents are frequently closely applied to it, if they are not adherent to its inner surface.

When the contents have been laid bare, they will be seen to consist of either intestine or omentum, or both. The omentum is likely to have formed connections with the testis or the sac wall, but the bowel is usually free. It is not generally necessary to divide any of the tissues constituting the constricting force, for, as a rule, they can be readily stretched—a method of dealing with them that is less likely to lead to their remaining dilated after the operation has been completed.

When the constriction has been removed the bowel should

be carefully drawn down and the actual site of the pressure upon it inspected.

If it is not so damaged as to be in all probability incapable of recovery it is replaced within the abdomen, and the rest of the operation finished in the manner described for a bubonocele which is reducible. If gangrenous it will have to be resected or an artificial anus established.

2. Scrotal Hernia in Association with Imperfect Descent of the Testis.

Out of 902 instances of hernia associated with imperfect descent of the testis, 138 were found of the scrotal variety, 80 being on the right side and 58 on the left.

A scrotal protrusion is here meant to imply a hernia which, having left the inguinal canal through the superficial ring, has passed into the scrotal tissue, and has not distended the fold between the scrotum and the thigh.

A scrotal hernia is, therefore, covered with dartos tissue, and more or less fills the scrotum, which, until the entrance of the hernia into it, had remained undistended, owing to the absence of the corresponding testicle.

When the scrotum is but poorly developed, then the hernia will have to actually dilate the parts, so as to obtain room for itself.

The explanation of the occurrence of the scrotal protrusion is the fact that a pouch of peritoneum is so frequently drawn down by the gubernaculum into the region of the scrotum beyond the site of the arrested testis. Accompanying this prolongation of the serous membrane there may be a loop of the vas deferens, or even of the epididymis.

In some instances the scrotal hernia may assume considerable proportions, becoming quite as large as any ordinary complete inguinal hernia with the testis in the scrotum; but generally it remains somewhat small, owing to the ill-development of the purse into which it descends.

As a rule, these scrotal herniæ are completely reducible, and after the reduction of the contents of the sac the ill-developed or atrophied testis can be felt lying in the inguinal

PLATE XXVII.

FIG. 52.—A RIGHT TESTIS LYING HIGH IN THE SCROTUM, WITH A HERNIA DESCENDING ON TO IT.

PLATE XXVIII.

Fig. 53.—Dissection of a Scrotal Hernia associated with Inguinal Testis. (Godard.)

A, Testis arrested in the inguinal canal; B, aperture of communication with general cavity of the peritoneum; D, portion of processus vaginalis; E, diverticulum therefrom; F, scrotal portion of sac.

Fig. 54.—Dissection to show Abdominal Retention of the Left Testis accompanied by a Hernia.

A pouch of peritoneum is protruded into the upper part of the scrotum, constituting the sac of a hernia. The right testis is normal in size and position, but its processus vaginalis remains patent. (Guy's Hospital Museum.)

canal, just below the superficial ring or high in the scrotum, the last position being the most common. Rarely the gland remains within the abdomen, and yet a scrotal hernia is present.

Most of the cases of scrotal hernia associated with imperfect descent of the testis are instances of neglected protrusions, which, commencing as bubonoceles, have advanced until the viscera reach the scrotum.

When the testis is found to be lying outside the superficial ring it is usual for it to have reached that spot after the onset of the hernial protrusion, to have been brought there either by the pressure of the hernia above it, or by the natural processes already at work in causing the descent continuing after a hernia has commenced.

Scrotal herniæ are apt to become the seat of strangulation, the site of the constriction being either at the deep or at the superficial ring.

When the testis is arrested within the canal, and a pouch of peritoneum has descended into the scrotal tissues, the superficial ring frequently remains very narrow. If on some expulsive effort the intestine is forced from the confines of the canal through the superficial ring and into the upper part of the scrotum, the edges of the ring will press banefully upon the delicate structure of the bowel.

Here, again, the effect on the wall of the intestine is likely to be very serious and rapidly brought about, so that the quicker the gut is freed the more hope there is of recovery.

Treatment.—The treatment of a scrotal hernia in connection with an arrested testis is either palliative or operative. Although many instances of such herniæ can be efficiently controlled by an inguinal truss with an ordinary pad, it is much less likely that the viscera will be so retained than when the hernia is one accompanying a testis that has reached the scrotum. Cases of scrotal hernia with an imperfectly descended testis, therefore, as a rule, require a more elaborate truss than one with the usual pad. A rat-tail or even a forked-tongue truss will be required.

The form and adjustment of a rat-tail truss are matters of some moment, and particularly so when the instrument has

to control a hernia which has developed in connection with an arrested testicle.

In a rat-tail truss the pad should be fuller than it is in the ordinary inguinal, and there should be depending from its lower and inner end a tail consisting of a tapering piece of soft material, and prolonged into a strap, which takes the place of the usual under-strap, and is fastened to a fixed hook just behind the shoulder of the truss.

It is absolutely necessary that the metal of the pad should not pass down into the tail. If such were the case, and the imperfectly descended testis was lying in front of the body of the os pubis, its sensitive tissue would thereby be caught between the firm metal in front and the unyielding bone behind, and unbearable discomfort would ensue.

On the other hand, if the material from which the tail is formed is quite soft, the testis is not harmed, and readily slips aside. Although this may appear to be a somewhat trivial matter, yet in actual practice it has the greatest importance.

The adjustment of a rat-tail truss is such that the pad should rest in the same position as does an ordinary inguinal pad—that is, over the line of the canal, and thus guarding the deep ring—while the tail portion is brought down in the fork between the scrotum and the thigh in a way that it will rest quite comfortably, and the end of the under-strap is attached to the fixed hook just behind the shoulder of the truss. It is desirable that this hook should not be movable, for if it were then there would be a tendency for the under-strap to be carried too far back, a position which would cause annoyance.

In those cases in which a rat-tail truss fails to efficiently retain the hernia, it will be necessary to employ a forked-tongue truss. This is a modification of the rat-tail, in which there is a prolongation of the soft material of the pad at the upper and inner end of the pad, from which a strap arises, which passes to be attached to a buckle at the shoulder of the truss on the side opposite to the hernia.

By this means the tendency there is for the tail to drag the pad off the region of the canal is considerably

lessened, and the viscera more effectually retained within the abdomen.

In the operative treatment of scrotal hernia associated with imperfect descent of the testis the principles that are to be followed are much the same as those which have been already laid down in the case of a bubonocele with a hernial protrusion.

The incision should be made over the line of the inguinal canal, and should not encroach upon the tissues of the scrotum. In this way more certainty of asepsis is assured, and the arrested testis, if lying in the canal, can be more easily dealt with.

When the testis is situated just below the superficial ring, then an attempt may be made to bring it further down into the scrotum, for the former spot is one of the most inconvenient in which it can reside.

As a matter of fact, however, most of the glands have been arrested in front of the body of the os pubis, are much undersized, and generally incapable of producing spermatozoa, so that, if the consent of the patient has been obtained previously to the operation, it is best to remove them, and then to carry out a complete operation upon the hernial sac.

In cases of strangulation the greatest care must be taken to fully inspect the intestine at the site of the constriction, for gangrene is common.

3. INTERSTITIAL HERNIA IN ASSOCIATION WITH IMPERFECT DESCENT OF THE TESTIS.

Definition. — By an interstitial hernia is understood an inguinal hernia, a part or the whole of the sac of which is placed in one or other of the planes of the abdominal wall, and which transgresses the ordinary limits of a bubonocele. Interstitial herniæ may be associated with imperfect or abnormal descent of the testis.

On the other hand, interstitial herniæ are also seen in males whose testes have reached their normal position in the scrotum, though these may not be fully developed; and they

are likewise formed in the female subject, and proportionately in a greater number than in the male sex.

Again, all instances of inguinal herniæ associated with imperfect descent of the testis are not of the interstitial variety.

These statements of fact go to prove conclusively that imperfect transition of the testis is not a necessary concomitant of an interstitial inguinal hernia.

An examination, however, of a large number of cases of this form of hernia in males leads to clear evidence that imperfect descent of the testis has a marked bearing upon the development of an interstitial protrusion. It will not be here necessary to enter at full length into all the causes of interstitial herniæ, but to consider in some detail the relationship there is between the arrest of the testis and the formation of an interstitial sac.

Varieties of Interstitial Herniæ.—There are three chief varieties of interstitial inguinal herniæ, and they are classified according to the plane of the abdominal wall in which the interstitial portion of the sac lies.

1. That in which the interstitial sac is to be found in the plane between the aponeurosis of the external oblique and the muscular tissue of the internal oblique.

This is the most usual variety.

2. That in which the interstitial sac is to be found in the plane between the aponeurosis of the external oblique and the skin.

This is the next in frequency.

3. That in which the interstitial sac is to be found in the plane between the transversalis fascia and the peritoneum— that is, in the extraperitoneal tissue.

This is very rare.

PLATE XXIX.

PLATE XXX.

FIG. 56.—A LARGE RIGHT INTERSTITIAL INGUINAL HERNIA,
REACHING TO THE COSTAL ARCH.

The right testis was retained.   Note the developed but undistended
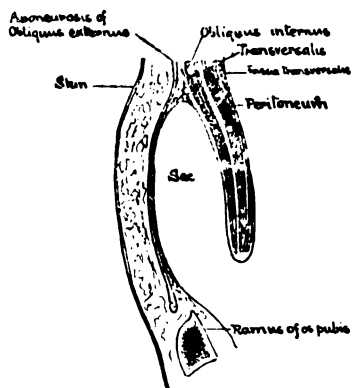right half of scrotum.

PLATE XXXI.

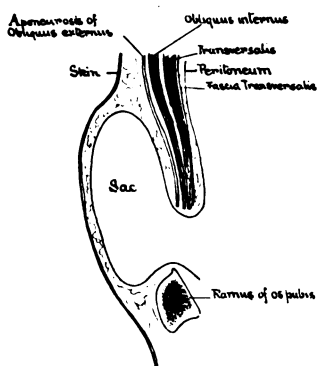

FIG. 57.—FIRST VARIETY OF INTERSTITIAL HERNIA.

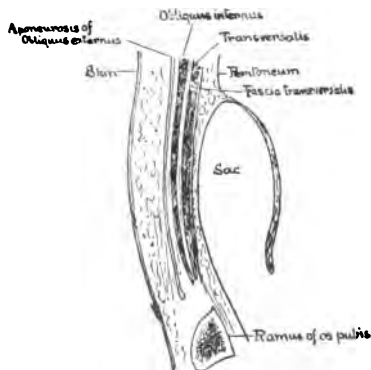FIG. 58.—SECOND VARIETY OF INTERSTITIAL HERNIA.

FIG. 59.—PRO-PERITONEAL HERNIA.

(Taken from the Author's work, 'Hernia: its Etiology, Symptoms, and Treatment.')
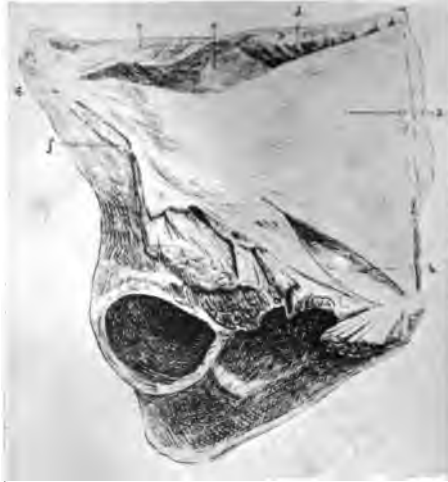
PLATE XXXII.

PLATE XXXIII.

FIG. 61.—DISSECTION OF A RIGHT INTERSTITIAL INGUINAL HERNIA OF THE FIRST VARIETY, THE TESTIS BLOCKING THE ENTRANCE INTO THE SCROTUM. (FRORIEP.)

a, a, Poupart's ligament; *b,* site of superficial ring; *g,* scrotal portion of hernial sac; *h, h,* fibres of internal oblique; *i,* upper end of interstitial sac; *k,* interior of scrotal portion of processus vaginalis; *y,* spermatic cord; *x,* testis at lower part of canal.

PLATE XXXIV.

FIG. 62.—A RIGHT INTERSTITIAL INGUINAL HERNIA OF THE FIRST
VARIETY; TESTIS FULLY DESCENDED. (FRORIEP.)

a, a, Poupart's ligament; *b,* site of superficial ring; *g,* scrotal portion
of hernial sac; *h, h,* fibres of internal oblique; *i,* upper end of inter-
stitial sac; *k,* interior of scrotal portion of processus vaginalis;
y, spermatic cord; *x,* testis at lower part of canal.

The Relationship of Imperfect Descent of the Testis to Interstitial Inguinal Hernia.

Frequency of the Association.—In males 73·4 per cent. of interstitial inguinal herniæ are associated directly with more or less imperfect descent of the testis.

Out of 834 instances already alluded to of persons the subject of arrest or misplacement of the testis and accompanied by hernia, 39 presented the interstitial variety, showing that about 5 per cent. suffered from this form of hernia.

These 834 persons were found among 41,280 males with inguinal hernia, so that only 0·094, or nearly 0·1 per cent., of inguinal herniæ, are interstitial in their character. In women, on the other hand, there were 19 cases among 4,500 females with inguinal herniæ, the percentage therefore being as high as 0·42.

Side Affected.—The 39 males the subject of interstitial hernia had the hernia on the right side in 29 instances, on the left in 8, and on both in 2, making in all 41 herniæ of the interstitial variety.

One on the right side was associated with the left testis in the canal, and therefore the imperfect descent had but little to do with the actual development of the interstitial sac. It will be noticed that there is a greater proclivity for the right side to be affected with interstitial hernia than there is for it to be the site of the arrest of the testis.

Position of the Arrested Testis.

The exact site of the imperfectly descended testis is a matter of great interest, in view of the relationship that undoubtedly exists between the two conditions. The position which was observed was that in which the testis was found. at the time when the patient presented himself for treatment, and it does not, unfortunately, necessarily imply that this was the site of the testis when the hernia first made its appearance.

It is not, however, common for the testis to alter its

position after the onset of a hernia, though that this may occur there are numerous instances on record.

In thirty-four instances the arrested testis was found in the inguinal canal, and in most of these it occupied a position at the lower end of that space. In another seven instances it hung just below the superficial abdominal ring ; in other words, it had only just left the canal, and it is conceivable that in some at least of these it was in the canal at the commencement of the hernia. In eight it was placed high in the scrotum, and in three also it was completely retained within the abdomen.

In one it lay near the anterior superior spine of the ilium, in which case it reached its abnormal position either through an unusual aperture in the aponeurosis of the external oblique muscle, or by passing through the superficial ring and then turning upwards and outwards on the anterior surface of the external oblique. In another it was also in front of the external oblique aponeurosis, but not so far out, lying over the region of the deep ring. This spot was gained in one or other of the ways mentioned.

In one it was found to be in Scarpa's triangle, and had passed through the superficial ring and thence into the upper part of the thigh. In the last case it was in the canal on the left side, but the interstitial hernia was on the opposite side—the right.

It will thus be evident that the inguinal inclusion of the testis is by far the most common form of arrest to be associated with an interstitial hernia, and this, as will be shown, is only what would be expected.

Development and Size of the Associated Imperfectly Descended Testis.

In the majority of instances the testis is poorly developed. In some it is only small ; in others it is found to be frayed out, and possibly only represented by its epididymis. Those testes which are found just below the superficial ring are particularly prone to be undersized.

The arrested testis is not infrequently tender on palpation.

Causation of Interstitial Hernia.

It remains to be seen how the imperfectly descended testis acts in the etiology of interstitial hernia. Several theories have been advanced to explain the relationship between the two conditions.

Position of the Testis.—The testis, if lying in the inguinal canal, and especially if occupying a position at its lower and inner end and further tethered by a short cord, will act as a barrier to the exit of the contents of a hernial sac through the superficial abdominal ring.

During expiratory efforts viscera are driven into a patent processus vaginalis testis. Further, similar efforts after a time tend to force both testis and viscera from the canal through the superficial ring. The gland, however, is pre-vented from extruding on account of the shortness of its cord, and being pushed against, and possibly into, the superficial ring, effectually closes the aperture for the pro-gress of the viscera. Moreover, its action in thus obstruct-ing descent will be enhanced if the ring itself is but a narrow one.

The smallness of the superficial ring may have been a factor which led to the non-descent of the testis, and there-fore this is a primary cause of the interstitial hernia rather than the arrest of the testis. The exit of the canal being blocked in this manner, the viscera in the processus vaginalis have no choice but to turn in the plane of least resistance, and this is usually that between the aponeurosis of the external oblique and the fibres of the internal oblique muscles.

The peritoneum is, therefore, stretched in this direction, and the secondary interstitial pouch is formed.

Want of Muscular Development.—The fact that imperfect descent of the testis is apt to be associated with a want of muscular development in the inguinal region has a bearing upon the formation of an interstitial hernia.

It has been questioned as to whether the abnormal con-dition of the muscles is not rather the result of the pressure exerted by the hernial protrusion than the cause of the formation of the sac. The tissues of the abdominal wall

behind the interstitial sac have been found to be almost devoid of true muscular fibres, and to present a thin translucent membrane with only a few atrophic fibres of striped muscle scattered here and there.

Moreover, there has been noticed an obliteration of the layers in front of the interstitial sac. But it is not always that such an alteration in the nature of the layers of the abdominal wall is present, although it would seem that it is by no means infrequently in evidence. If such a condition of the muscles of the inguinal region were a constant, or even a frequent, association of imperfect descent of the testis, then interstitial herniæ would be more common than they are, for the arrest of the testis is not an unusual occurrence, but the hernia associated with it is only in 5 per cent. of the cases interstitial.

And, further, in women, in whom it has yet to be shown that there is a congenital anomaly as a factor of the formation of interstitial herniæ, this variety of an inguinal protrusion is proportionately more frequent than it is in the male sex. Therefore, while admitting that the want of proper development of the lower musculature of the abdominal wall may be one of the causes of the production of an interstitial sac, it cannot be allowed that it is so general a one as has been supposed by some authorities.

There is yet another anomaly of the muscular formation in the inguinal region which has been advanced to suggest a cause of an interstitial hernia, and this is the outward and upward displacement of the abdominal opening of the processus vaginalis—in fact, of the deep abdominal ring. It has been said that this is due to an abnormal, and therefore faulty, insertion of the inguinal band of the primordial kidney on the abdominal wall.

If the exit of the testis through the parietes is placed at a spot nearer the anterior superior iliac spine than is usual, the spermatic cord may be too short to allow the testis to pass further in its migration than into the canal. Once again it would be this primary cause that is the real factor in the production of the interstitial sac rather than the arrest of the testis, which is only the secondary aid.

Other Conditions associated with Imperfect Descent.—An abnormal drag of the gubernaculum testis upon a portion of the peritoneum near to the ostium abdominale of the processus vaginalis. Certain it is that adventitious pouches have been formed in this manner, and therefore one or more can be associated with a hernia in the process itself, and thus constitute the third form of interstitial hernia.

A greater looseness of the parietal peritoneum around the margin of the opening from the general cavity of the peritoneum into the congenital pouch accompanying the testis in its descent has also been surmised as well as a resistance at the entrance of an imperfectly developed scrotum.

When all these various suggestions as to the causation of an interstitial hernia are reviewed, it will be seen that they have one common attribute, and that is that they are of congenital origin, and so it must be considered that interstitial herniæ are generally the outcome of a defect present even before birth.

Signs and Symptoms of Interstitial Hernia.

1. First variety, in which the interstitial sac is placed between the aponeurosis of the external oblique and the internal oblique muscular fibres. This form of interstitial hernia is the most often seen, and is one that is frequently associated with an arrest of the testis.

As a rule, even in its earlier stages, it presents an external swelling. This is very characteristic in its shape and extent. Beginning in the region of the canal, it mounts upwards and onwards towards the anterior superior spine of the ilium. The whole course of the gradual formation of the tumour can be observed if a patient, after the contents of the sac have been reduced, is directed to lie on his back and to cough. There is no other condition which will give this spectacle. The shape of the swelling is ovoid, and its margins are fairly distinct. It is flattened, and does not project far from the surface at first. The limits of the tumour are wide. It may reach as high as the costal arch, and may overlap the rectus muscle, and may even hang down in front of Poupart's ligament, so as to simulate a

femoral hernia that is mounting upwards from the thigh in front of that ligament. When, however, the swelling is of so large dimensions, a portion of the sac will probably be found to occupy the space between the external oblique and the skin, and is therefore partly of the nature of the second variety.

The contents of the sac can generally be reduced, though sometimes it is a difficult matter to entirely empty it. When reduction has been effected, the ill-developed testis can be made out lying in the inguinal canal, unless it is arrested elsewhere, and often a band from it is discovered passing through the superficial ring into the area of the corresponding half of the scrotum, which is not, as a rule, well developed.

At other times the testis will be found just below the superficial ring, or at some spot on the way to the anterior superior spine of the ilium.

In addition to the interstitial portion of the sac, there may be a part running down into the upper half of the scrotum. An indication of the position of the superficial ring will be shown by a distinct groove between the two divisions of the sac.

The scrotal portion is usually secondary to the interstitial, and may be formed when the resistance to the increase in the primary part has become greater than the resistance to the entry of the scrotum.

2. *Second variety*, in which the interstitial sac is placed between the aponeurosis of the external oblique and the skin.

The form of interstitial hernia here noticed is the second most common variety. It is also not infrequently associated with an arrested testis.

The method in which the sac has arrived at its position may be one of two. Either the peritoneum has been pushed forward and then upward through a gap in the aponeurosis of the external oblique—in most cases constituting an enlarged superficial ring—or the sac, at first lying in the inguinal canal, has transgressed the bounds of this space, and, protruding from the superficial ring, finds

that its way into the scrotum is blocked, and then turns upward on to the abdominal wall.

In both of these the direction taken by the hernia is the one of least resistance, for the attachments of the deep layer of the superficial fascia to the front of Poupart's ligament will bar its progress into the thigh. As a rule, the external swelling present in this second variety of interstitial hernia is more pronounced than that of the first variety. It is prone also to assume larger lateral proportions, as well as to protrude to a greater extent.

On reduction of the contents of the sac, usually by taxis applied in a downward and inward direction, the gap in the aponeurosis or the enlarged superficial ring can be readily palpated, and may be of sufficient size to easily admit several fingers.

At the same time the position of the arrested testis will be determined. This form may reappear almost spontaneously when the patient makes the least effort, such as merely raising the head from the pillow. It is sometimes very difficult, chiefly owing to the extreme thinness of the overlying tissues, to be sure whether the hernia that is being examined is one belonging to the first or the second variety of interstitial inguinal hernia.

Some help may occasionally be obtained by requesting a recumbent sufferer to raise the head and shoulders from the pillow, and thus to throw into action the abdominal muscles, when, if the external oblique is placed in front of the sac, the hernia will become more tense, but will not increase very greatly in size; while should the aponeurosis be posterior to the bulk of the swelling, then this is markedly enlarged, but its tenseness will only be augmented in proportion to its size.

The third form of interstitial hernia is so distinctive that it will be discussed by itself at a later period.

The Diagnosis of the First and Second Varieties of Interstitial Hernia.

There are several conditions which have been mistaken for an interstitial hernia, and such a form of protrusion has been thought to be quite another lesion.

Iliac abscesses, intermuscular lipomata, the lateral bulgings often seen in the lateral wall of those suffering from hernia, bilocular hydroceles, have all been diagnosed as interstitial herniæ. In many instances it is almost impossible to be certain of the lesion that is present until the parts are exposed by operation. On the other hand, an interstitial hernia has been mistaken for a renal swelling, particularly a hydronephrosis, and in another instance as a hydatid cyst of the abdominal wall.

As a rule, the percussion note should prevent a mistake arising, for most of these swellings that have been confused are dull, while an interstitial protrusion is nearly always resonant.

Prognosis of the First and Second Varieties of Interstitial Hernia.

Interstitial herniæ, if left untreated, tend to steadily advance and to comparatively rapidly increase in size. They are further prone to become irreducible in part or wholly.

Strangulation is not so very frequent, but if it should supervene it is likely to be very severe, and to lead to fatal results in not a few instances. Operations upon interstitial herniæ are difficult, and their cure by such measure is by no means certain.

Treatment of the First and Second Varieties of Interstitial Hernia.

There cannot be any doubt that in the greater number of instances of interstitial herniæ seen after quite early infancy are best submitted to treatment by operation.

There will, however, always be a certain proportion in which such a method of treatment is contra-indicated, as in the very young, the very obese, in those suffering from visceral lesions, the very old, and where the hernia has reached enormous proportions.

Palliative Treatment of Interstitial Hernia.

That truss pressure will be of great service in those cases which cannot be submitted to operation has been abundantly

demonstrated, and the wearing of such an instrument is not only useful in retaining the contents of the sac, but in tending to diminish very noticeably the size of the protrusion. Therefore the prognosis of those cases in which palliative measures are the only ones that can be adopted is not by any means hopeless. Each case has to be taken on its own merits, and frequently a specially constructed truss will be all that is needed to effectively control the hernia.

In the early stages of an interstitial hernia the protrusion can be retained by the application of an ordinary inguinal pad, provided that it is adjusted well over the inguinal canal, and not, as is so frequently the case, over the superficial ring, or even on the upper part of the thigh. Out of forty-one instances of interstitial herniæ in males of all ages, it was found that the hernia could be controlled by the usual inguinal truss in no less than twenty-five cases.

Here, as in other forms of inguinal hernia associated with an arrested testis, the gland may be disregarded so far as the truss is concerned, for it will generally find a comfortable bed for itself, and will not be inconvenienced by the pressure of the instrument.

In those instances where there is a tendency for a protrusion to descend into the upper part of the scrotum, it is often desirable to use a rat-tail truss, such as has been described on p. 102.

Another form of truss that is of great service in the treatment of the more advanced cases of interstitial hernia, those that are mounting up towards the iliac spine, is the one with an interstitial plate. In this the pad is larger than the ordinary inguinal form, and rises from that upwards and outwards, so that its highest limit is just within the anterior superior spine. It may be necessary in ordering such a truss to carefully delineate a pattern, in order to obtain accurately the position and extent of the pad.

Should the hernia present not only an abdominal portion of sac, but also a scrotal, both of some magnitude, then it will be requisite to add to the interstitial plate a tailpiece similar to that used in the rat-tail.

A comparatively small irreducible interstitial hernia in a

8

subject upon whom an operation cannot be performed must be treated by the application of a hollow interstitial plate, which by its pressure may actually bring about the return of the contents of the hernial sac.

Should there be a hernia on the side opposite to that on which the interstitial is present, then a double truss will be needed with an appropriate pad for the second hernia. An enormous hernia may require an abdominal belt in addition to a truss.

Operative Treatment of Interstitial Hernia.

This should always be advised unless contra-indicated. The probability of cure after a radical operation upon an interstitial hernia is not so great as it is after such an opera- tion performed upon an ordinary congenital inguinal hernia, and this for the reason that there is so commonly some congenital defect of the abdominal wall which has aided in the production of the protrusion.

The patient having been prepared for the operation, an incision is made over the line of the inguinal canal. When the contents of the sac are not wholly reducible, great care must be exercised not to injure the intestine, for the tissues lying over the hernia may be very thin, especially in the second variety of the protrusion. If the peritoneal pouch is found lying superficial to the aponeurosis, it should be dis- sected out and its deeper connections traced.

If the interstitial portion is posterior to the aponeurosis, the fibres of this layer will need division, as they will also in the second variety when the superficial portion of the sac has been cleared out.

In order to fully remove the peritoneal pouches, it may be necessary to carry out an extensive dissection involving the division of a considerable amount of the aponeurotic and muscular tissue, and it is this fact which renders the sub- sequent history of the case rather uncertain.

The arrested testis is to be dealt with in the manner that has been already described (p. 93).

Careful suturing of the divided layers will complete the operation. It may be well in some cases to provide for

drainage if the dissection should have involved extensive areas or the whole of the sac has not been removed.

In many cases a truss should be advised after an operation upon an interstitial hernia, for unless a cure does result a return is liable to be more severe than the original protrusion.

Operative procedures upon a strangulated hernia of these varieties is carried out in a similar manner to that detailed for a reducible hernia. The site of the constriction will generally be found deeply situated.

3. *Third variety*, in which the interstitial sac is placed between the transversalis fascia and the peritoneum in the extraperitoneal tissue. This is a rare form of interstitial hernia, and one that is not so commonly associated with arrest of the testis. There is usually a scrotal portion of the sac in addition to the interstitial.

From the position in which the sac lies, the hernia is sometimes spoken of as a pro-peritoneal hernia. In almost every instance the additional sac within the abdominal wall has not been recognised until it has been exposed after death or during an operation upon a hernia in the inguinal region. This is on account of the pro-peritoneal portion not exhibiting any ventral swelling, and it is therefore only when strangulation of its contents ensues that attention will be drawn to it.

There are two chief sites in which the secondary sac may be placed : one is the iliac fossa, and the other the pre-vesical region.

When a patient presents the signs of intestinal obstruction, perhaps of not a very acute nature, and has an anomaly of the testis, together with an indefinite swelling, or possibly only a tumefaction, in the iliac or the inguinal region, a surmise may be made that there is a pro-peritoneal sac in which intestine has become strangled. No time should be lost in making the diagnosis certain by an operation, and in order, further, that the imprisoned bowel may be liberated.

Instances of this form of hernia are very grave, as the indefiniteness of the signs favours unwarrantable hesitancy

8—2

on the part of the observer, and leads to operative measures being delayed until gangrene of the nipped intestine has supervened.

4. CRURO-SCROTAL HERNIA IN ASSOCIATION WITH IMPERFECT DESCENT OF THE TESTIS.

Definition.—A hernial sac which distends, not the scrotal tissues, but the fold of skin which is found between the scrotum and the thigh. The hernia will, therefore, be covered with ordinary cutaneous tissue and not with the dartos.

Etiology.—The hernia follows the testis. A testis, usually an imperfectly developed one, having left the inguinal canal, is for some reason—probably either a want of development of the scrotal tissues or a denseness of the fascia at the entrance of the scrotum—prevented from continuing its further descent into the scrotum. It will, therefore, remain permanently in the cruro-scrotal fold or pass into the perineum or into Scarpa's triangle.

If the processus vaginalis testis which accompanies it remains patent, viscera may descend into it, and gradually distend the fold, and so form a cruro-scrotal hernia.

As the hernia progresses, the pouch becomes larger and more definite, but hangs downward, and does not pass backward into the perineum. This variety of hernia may occur at almost any age, but probably it has its beginning in early infancy.

Signs and Symptoms.—On examining a patient the subject of this form of hernia, it will first be noticed that the scrotum is either imperfectly developed on one side, or that, being developed, it is undistended. Lying by its side and separated from it by a distinct sulcus is an adventitious sac covered with normal skin. On the patient being requested to cough, an expansile impulse will be felt in the swelling. In the recumbent position the contents of the sac can generally be reduced, and, after reduction, the small testis will be felt usually at the bottom of the pouch. The gland is fixed there, as a rule, and cannot be made to return with the contents of the sac.

PLATE XXXV.

FIG. 63.—THE RIGHT TESTIS LYING IN A POUCH OF SKIN BETWEEN THE SCROTUM AND THE THIGH, AND NOT COVERED WITH DARTOS TISSUE.

A hernia is entering the pouch above the testis.   (Photo of a man, aged forty.)

PLATE XXXVI.

FIG. 64.—A RIGHT CRURO-SCROTAL HERNIA.

The right testis was not in the scrotum.

FIG. 65.—DISSECTION TO SHOW ON THE LEFT SIDE A HERNIA IN CONNECTION WITH A TESTIS IN THE CRURO-SCROTAL FOLD. (GODARD.)

F, Testis; G, epididymis; H, cord; I, sac; K, intestine; P, raphé.

PLATE XXXVII.

FIG. 66.—THE RIGHT TESTIS IN A CRURO-SCROTAL POUCH,
ACCOMPANIED BY A HERNIA.

Note the secondary pouching of the sac, and the development of the
right half of the scrotum.

PLATE XL.

Fig. 69.—Left Testis in the Perineum, together with a Hernial Protrusion into the same Region—a Superficial Perineal Hernia.

(See also Fig. 11.)

The pouch of skin, when the viscera are not distending it, hangs lax and thrown into folds. Sometimes the skin is very much stretched, and the contents of the hernia become almost visible through it.

In one case lately observed, probably owing to a previous puncture for a supposed hydrocele, a diverticulum was found at the side of the original sac. From its inconvenient position the protrusion, if at all large, is liable to superficial injury, leading to excoriation, and even ulceration, from friction and pressure. Even when the sac assumes larger proportions, there is no tendency for the penis to become buried, as it so often is in big scrotal herniæ.

Diagnosis.—The only condition which has been mistaken for a cruro-scrotal hernia was a fibro-cellular tumour depending from the fork between the scrotum and the thigh. The absence of the testis from the corresponding side of the scrotum, the impulse on cough, and the reducibility, should readily indicate the presence of a hernia.

5. Superficial Perineal Hernia in Association with Imperfect Descent of the Testis.

Definition.—A hernia which accompanies a testis into the tissues of the perineum. It is designated 'superficial' to distinguish it from that rare form of perineal hernia which leaves the pelvis through a gap in its floor. The course of the descent of the superficial perineal hernia is from the abdomen along the canal, through the superficial ring, by the side of the scrotum near its entrance and backwards towards the margin of the anus. This form of hernia is necessarily rare, for perineal ectopia testis is uncommon, and an accompanying hernia but seldom seen.

Signs and Symptoms.—When present there will be an elastic swelling on one side of the perineum, with an expansile impulse on cough, frequently resonant on percussion, and, as a rule, reducible on pressure. After the return of the contents of the sac, the testis, sometimes well developed, can be felt lying by the side of the anus, and often tethered

by a band, probably of the gubernaculum, to the region of the external sphincter or the tuberosity of the ischium.

Diagnosis.—It is unlikely that a superficial perineal hernia would be confused with an abscess in the same part, but the absence of the testis from the corresponding half of the scrotum, the impulse in the swelling on cough, and its reducibility, all point to the presence of a hernia.

CHAPTER VII.

HYDROCELE IN ASSOCIATION WITH IMPERFECT DESCENT OF THE TESTIS.

WHEN the testis has been arrested within the abdominal cavity, no intra-abdominal tunica vaginalis will be formed, and consequently no intra-abdominal hydrocele can be in evidence; but when the testis has passed beyond the bounds of the abdominal wall, then a tunica vaginalis will be in existence, and a hydrocele may be found. Further, it is true that even when the testis remains behind within the abdomen the processus vaginalis may be drawn down into the inguinal canal, the scrotum, or even into the perineum or Scarpa's triangle. It is possible, therefore, for there to be a hydrocele outside the abdominal wall, with the testis completely retained within that cavity.

Classification.

1. *Inguinal.*
2. *Scrotal.*
3. *Bilocular and Trilocular.*
4. *Perineal.*
5. *In Scarpa's triangle.*

Inguinal Hydrocele.

Inguinal hydrocele may be further subdivided thus :
(*a*) *With the Testis lying within the Abdomen.*—1. The processus vaginalis still in communication with the peritoneal cavity.

2. The processus vaginalis shut off from the peritoneal cavity.

(*b*) *With the Testis lying in the Canal.*—1. With the tunica vaginalis still in communication with the peritoneal cavity.

2. With the tunica vaginalis shut off from the peritoneal cavity.

Inguinal Hydrocele with the Testis within the Abdomen.— When the processus vaginalis has been formed, and yet the testis lies within the abdominal wall, it is usual for the peritoneal pouch to retain its communication with the general cavity of the abdomen.

Fluid, therefore, that is found within it has either been secreted *in situ* or has descended from the peritoneal cavity, and in both cases it will be freely reducible without the sensation of any solid organ slipping away from the fingers, as would be the case supposing that a hernia was present.

When, on the other hand, the less common condition is in existence, in which the peritoneal pouch has had its connection with the peritoneum severed, then any collection of fluid will be irreducible, and will appear as a swelling identical with the inguinal hydrocele to be presently described, except for the fact that at no time can the testis be felt within the sac.   Both these forms of hydrocele are best treated by operative measures.

Inguinal Hydrocele with the Testis in the Canal.—This variety of hydrocele is by far the commonest form met with in connection with an arrested testis.   It may be further subdivided as follows :

1. With the tunica vaginalis still in communication with the general cavity of the peritoneum.

      (*a*) Communication free.

      (*b*) Communication blocked by testis.

2. With the tunica vaginalis shut off from the general cavity of the peritoneum.

      (*a*) Unilocular.

      (*b*) Multilocular.

Inguinal hydroceles may also be classified under the headings of acute and chronic, or spontaneous and inflammatory

PLATE XLI.
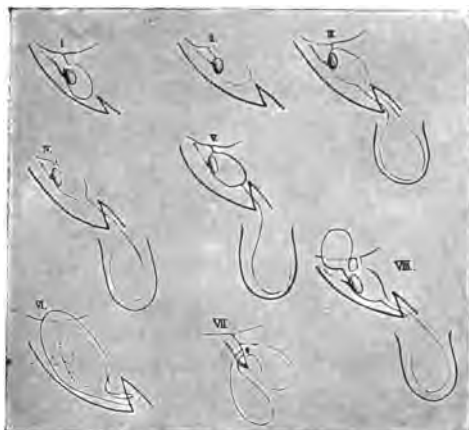
FIG. 70.—DIAGRAMS TO ILLUSTRATE THE VARIETIES OF HYDROCELE
WHICH MAY BE ASSOCIATED WITH IMPERFECT DESCENT OF THE
TESTIS.

I, Inguinal, shut off from general peritoneal cavity; II, inguinal, com-
municating with general peritoneal cavity; III, bilocular, shut off
from general peritoneal cavity; IV, bilocular, communicating with
general peritoneal cavity; V, bilocular, the two parts separated from
one another; VI, interstitial, first variety; VII, interstitial, second
variety; VIII, trilocular, or interstitial, third variety.

The testis, when it lies within the inguinal canal, is not at all infrequently surrounded by fluid which has collected in its tunica vaginalis. This fluid may be ordinary hydrocele fluid, such as is met with in the vaginal scrotal hydrocele, or it may be of an inflammatory nature.

When the tunica vaginalis is still in connection with the peritoneal cavity the fluid which is within it can be readily pushed back into the abdomen in the majority of cases—indeed, it will often disappear spontaneously when the patient assumes the horizontal position. But in a certain number of instances the testis, situated at the upper end of the canal, acts as a plug to the deep abdominal ring, and thus prevents the return of any fluid that may have collected or formed in the tunica vaginalis. Instances of the former condition are not infrequently complicated by the descent of viscera, while the latter cannot, as a rule, be distinguished from an inguinal hydrocele, in which the tunica vaginalis no longer has an opening into the peritoneal cavity.

If a patient is troubled with a hydrocele in which the fluid is reducible, the case is one in which a hernia is always liable to be superadded, and the sufferer should either have a truss adjusted or should be submitted to operation, with a view to a cure of the hydrocele and a transplantation of the testis. It is not advisable to tap these forms of hydrocele, partly on account of their communication with the abdomen, and also from the fact that there may be a hernial sac, and partly because they nearly always recur if so dealt with.

When the opening that originally existed between the processus vaginalis and the peritoneal cavity is no longer patent, then may fluid be formed within the tunica vaginalis, which cannot be displaced out of the sac into the cavity of the abdomen.

(*a*) UNILOCULAR.—These may be acute or chronic. The *acute* unilocular hydroceles are generally the result of inflammation of the testis that lies in the canal, which inflammation is produced by traumatism or by some infection. The *chronic* unilocular hydroceles are generally the result of an inflammation that has been so slight as to pass unnoticed,

but they may also recur in a manner that would seem to be entirely spontaneous.

(*b*) MULTILOCULAR.—These are usually chronic, but have their origin in adhesions having been formed, the outcome of the inflammation, which was also the first cause of the collection of fluid.

In the 936 instances of imperfect descent of the testis accompanied by a hernia, thirty-two were associated with hydrocele ; and as many of the cases had been wearing a truss, it will be seen that truss pressure is not a marked cause of hydrocele.

Signs and Symptoms.—After a history of some amount of pain in the inguinal region, due to the inflammation of the testis, or occurring without previous warning, a swelling appears in the inguinal canal.   The increase of this tumour may be slow or rapid.

Most commonly the patient will continue to complain of pain in the organ, due in most cases to the associated orchitis, but also partly caused by the stretching of the tissues forming the inguinal canal.

The swelling, readily seen on examination, is usually ovoid in shape, is smooth on the surface, firm, tense, without an impulse on cough, save of a forward character, fluctuating, and dull.   Moreover, it is frequently somewhat tender on pressure, and particularly if the pressure be sufficient to displace the layer of fluid and allow the testis itself to be squeezed.   If the swelling should attain any larger proportions, translucency may be sometimes obtained.

At other times, owing to some absorption of fluid from the large sac, the swelling, instead of being tense, has become lax, and the position of the testis can be recognised by palpation, or by the elicitation of testicular sensation.

Diagnosis.—An inguinal hydrocele has to be diagnosed from an abscess, chiefly occasioned by suppurative lymphadenitis, and when very acute from a strangulated hernia.

The differential diagnosis has already been given when inflammation of the inguinal testis was being discussed (p. 23).   It must be further borne in mind that a collection of fluid in the tunica vaginalis may mask the presence of a new

growth of the testis, and if the fluid is by any means with-
drawn, a careful examination of the arrested gland should
always be made.

Treatment.—An inguinal hydrocele may either be left alone
or treated by operation.

Operative Treatment.—The operative treatment of an in-
guinal hydrocele is either that of tapping the sac, and thus
withdrawing the fluid, or of dissecting out the sac, and thus
removing the origin of the fluid.

Tapping in the case of an inguinal hydrocele is a method
of treatment by no means free from danger. There is the
fact that the hydrocele lies somewhat deeply placed in the
abdominal wall, that there may be a hardly perceptible
associated hernia, and that should there be a communication
with the general cavity of the peritoneum, any possible
septic infection may have the most disastrous results.
Further, in those instances in which the testis is lying in
the canal, there is always the danger that the organ may be
wounded by the trocar. In addition, such a withdrawal of
fluid will very probably be only a temporary relief from the
condition, seeing that the source of the exudation is left
present, and because it is inadmissible to inject into the
cavity of the sac any reagent that would be likely to set up
adhesive and obliterative inflammation on account of the
risk of involving the general cavity of the abdomen. It
therefore is undoubtedly best to deliberately expose the
sac by an incision made over it, and to deal with the
conditions as matters are found.

Should the testis still be within the abdomen, then all
that is required is to separate the sac from the tissues that
surround it, and, after carefully ligaturing its neck, to remove
it. Should the testis proper be still intra-abdominal, but the
epididymis or the vas deferens have descended into the canal,
then it is best to dissect off either structure from the posterior
surface of the sac, and to return whichever it may be into
the companionship of the testis within the abdominal wall,
and then to remove the protruding pouch of serous mem-
brane. On the other hand, if the testis has reached the cavity
of the canal, it must be either removed or transplanted.

If very ill-developed, and the patient has a normal testis on the opposite side, it is best to castrate, seeing that the organ if left, or even if transplanted, is liable to set up a fresh accumulation of fluid, and so produce a return of all the old trouble.

But should the testis appear to be well developed, or should there be an ill-developed gland on the opposite side, then an attempt must be made to transplant it into a more favourable position, both in the hope that in a young subject it may grow, and also that it may be less likely to be again surrounded with fluid. The methods of transplantation have already been described (p. 30).

Scrotal Hydrocele.

This is the term that should be given to those cases in which the processus vaginalis has passed beyond the retained testis and has reached the scrotum, possibly only into its upper portion, and in which that part of the pouch below the superficial ring becomes shut off from the rest, and subsequently distended with fluid. Such a condition is not so very uncommon.

The firm, tense, smooth sac containing the fluid is likely to be mistaken for a testis, particularly if the scrotum is well developed and there is no evidence of any inguinal swelling. Such an error in diagnosis will be avoided by paying attention to the fact that the swelling is translucent, and that it has no testicular sensation.

The treatment of these little hydroceles—for they do not, as a rule, attain any great size—is to remove them by dissection, and at the same time, if it is feasible, to deal with the arrested testis.

Bilocular Hydrocele.

First Variety.—The peritoneal process accompanying the testis is by no means infrequently drawn down into the scrotum beyond the site of the arrested testis, and in such a case the original communication with the general cavity of the abdomen may be closed, or it may remain patent.

If it is closed, then all the conditions necessary for the

development of a bilocular hydrocele are present, and the same may be said of those instances in which the imperfectly descended testis acts as a plug at the deep ring, preventing the return into the abdomen of any fluid collected in either portion of the tunica vaginalis.

Distension of the inguinal and scrotal parts of the peritoneal pouch will lead to the formation of one variety of bilocular hydrocele, and a swelling will be apparent both in the groin and in the scrotal bag. Both of these may be tense, or one may be lax and the other firm, and on pressure being applied to the less tense sac the other will immediately become more tense. Fluctuation can also be obtained through from one to the other. As a rule, both portions are translucent, and although the inguinal part may have a forward impulse on coughing, the scrotal part is not affected.

When the communication with the abdomen is cut off the fluid in both the swellings will be irreducible into that cavity. Where an aperture still exists, even though the testis may block the opening, there will be variations in the fulness and the tenseness of the swellings, and under certain circumstances the whole of the tumours may be made to disappear by reason of the reduction of their fluid contents. If the inguinal portion can be emptied, the testis, smaller than normal, can usually be readily palpated in the inguinal canal, and generally at the upper end of the passage.

In some instances the scrotal portion of the sac may be completely shut off from the inguinal portion, but both remain distended with fluid. Their separation is commonly at the site of the superficial ring. In this condition there can be no transference by pressure of the fluid contents of one portion of the sac into the other, each being a cavity distinct from the other.

Second Variety.—When the testis lies in the canal, and occasionally when it is arrested within the abdomen or just below the superficial ring, the portion of the processus vaginalis which resides in the canal becomes dilated with fluid, and this being for some reason unable to contain more without further space, a secondary sac, is formed in one of the planes of the abdominal wall.

In the first form of this, and that the most common, the additional portion of the sac is protruded in the space between the aponeurosis of the external oblique and the internal oblique muscle of the abdominal wall.

In the second form, the next in frequency, that in which the testis is lying usually outside the superficial ring, the primary pouch of peritoneum also traverses the same aperture, and then, instead of entering the scrotum, which may be practically absent, mounts upward and outward on the abdominal wall, in the plane between the aponeurosis of the external oblique muscle and the skin.

This is the superficial interstitial form of bilocular hydrocele, while the first form of such is the deep kind.

The third form is very rare, and consists of a secondary sac lying in the extraperitoneal tissue behind the body of the os pubis in the pelvis.

Signs and Symptoms.—The first and second forms of the second variety of bilocular hydrocele—namely, the superficial and the deep interstitial hydrocele—both show a definite external swelling. That of the deep form is apt to be somewhat less pronounced than that which is present in the superficial variety.

The fluid collecting in this sac is pressed upon by the aponeurosis of the external oblique muscle, and its walls are therefore generally made very tense when that muscle is put into action. Deep fluctuation will be obtained. The tumour is dull on percussion, has only a forward impulse (not an expansile one) on coughing, and is, as a rule, not reducible. Its size will vary very much, but it may reach very large proportions.

In the superficial variety nothing else lies between the skin and the sac save the subcutaneous tissues, and the imprisoned fluid can be readily palpated. The superficial pouch will effectually conceal the deeper portion lying in the canal, and it can be traced down to and through the superficial abdominal ring. It will again be dull on percussion, only receive a forward impulse on an expiratory effort, and be generally irreducible.

The third form does not admit of diagnosis before dis-

section, though it is possible that, should its existence be surmised, an examination *per rectum* might cause the finger to detect its presence.

Treatment.—Tapping of these forms of hydrocele is most commonly merely a palliative measure, in addition to having some danger in its performance on account of the depth of the sac. The cavity from which the fluid is thereby evacuated quickly becomes redistended. By far the most satisfactory method of dealing with them is to expose the sac by a free incision, and to dissect it out of the bed in which it lies. This treatment may involve some extensive dissection, and may tend in the deep form to leave the abdominal wall rather weakened. Should the deep sac be a very large one, it may be advisable merely to excise a portion of its walls, and to leave the remainder in the hope that obliterative inflammation will close the sac.

Trilocular Hydrocele.

A few instances of trilocular hydrocele have been seen. In these there is, in addition to the two pouches of the bilocular hydrocele just described, a third pouch, which lies in the upper part of the scrotum. The arrested testis is to be found either in the canal or just below the superficial abdominal ring. Probably in the majority of instances the inguinal and the scrotal portions are the first to be formed, and subsequently the interstitial diverticulum is produced. Trilocular hydroceles are best treated by a radical operation, excision of the whole or a part of the sac being adopted, together with the removal of the associated arrested testis.

Perineal Hydrocele.

When the testis has passed into the perineum, the processus vaginalis that accompanies it may become the site of a collection of fluid, usually as the outcome of an inflammatory process in the ectopic organ.

A swelling will form with more or less pain and considerable inconvenience when the patient attempts to assume the sitting posture. The tumour will be dull on percussion, and

will be irreducible as a rule. The absence of the testis from the corresponding side of the scrotum, and its possible detection on deep pressure of the swelling, together with the signs of fluid, will clearly indicate the nature of the swelling, save that it might be mistaken for a perineal abscess, from which it may be distinguished by the absence of any signs of inflammation.

Hydrocele in Scarpa's Triangle.

In a like way a testis that has become placed in Scarpa's triangle is liable to have its surrounding sac distended with fluid, usually as the outcome of inflammation. Here the swelling may be mistaken for a femoral hernia, for an abscess in connection with the lymphatic glands, or for varix of the saphena vein. It is generally too high up to be confused with a psoas abscess. The absence, however, of the testis from the same side of the scrotum, and the history of a swelling having been in the region almost from birth, will usually make the diagnosis evident.

Again, the sac and fluid should be removed by operation, and the testis, if feasible, transplanted into the scrotal tissues.

CHAPTER VIII.

FAILURE OF BODILY GROWTH AND BODILY DEFORMITIES DEPENDENT UPON OR ASSOCIATED WITH IMPERFECT DESCENT OF THE TESTIS.

THERE would appear to be some relationship between the general growth and development of the body in the male and the proper descent of the testis. The subject may perhaps be amplified by the following statements :

1. Arrest of one testis, with complete descent and growth of the opposite gland, is only very rarely associated with any deficiency in bodily growth.
2. Arrest of both testes, when they are ill-developed, is usually accompanied by some want of development of the body as a whole.
3. Arrest of both testes, but good development of both glands, is but rarely followed by or connected with imperfect development of the body.
4. Arrest of both testes, with want of development of only one of the organs, is not necessarily accompanied by a diminution of bodily growth.

1. When one testis is arrested or ill-developed there is, except in a few rare cases, no want of development of the individual, whether of bodily, mental, or sexual vigour. It would therefore appear that either the fully descended and developed testis is sufficient to promote, or, at any rate, does not hinder, bodily growth—that it has, in fact, some at present obscure qualities or functions that render it capable of playing an important rôle in the organism, in spite of its

9

fellow being functionless; or that in reality the arrested testis does subscribe its quota towards the full development of the individual.

If the former view is correct, it might be urged that the descended testis, in order to supply what was needful, ought to show signs of increase in size—in fact, exhibit a true hypertrophy. Yet a size of the normally placed organ greater than one should be in a person of corresponding age and growth is but rarely seen.

In animals, on the other hand, there does seem to be more evidence of increase in the fellow-gland when one has been arrested. In the horse particularly this is the case. Sometimes in these animals the descended testis may become twice the bulk that gland should be in a stallion of the same size and age.

Because, therefore, in the human subject hypertrophy of the descended testis is a comparatively rare condition, it still remains to determine whether the one fully descended and fully developed testis, although not larger than normal, is capable by itself of supplying the needed stimulus for full bodily development, or whether the arrested testis that is also present has to give its share towards the same result. Probably the question must be answered by stating that the single normal gland is capable of doing the work of two in every way, but that this does not necessarily mean that the imperfectly descended gland may not also assist. Should it therefore be deemed proper to remove in early life an arrested testis, or even one fully descended gland, no serious inconvenience to the patient is to be feared so far as complete bodily growth is concerned, and this in spite of the fact that the opposite gland does not show any tendency to increase in size.

2. In furtherance of the argument that an ill-developed and imperfectly descended testis does not subscribe much, if any, of the stimulus for full bodily development of the man is the fact that, in instances of double arrest and non-development of the testes, there is, as a rule, some failure in the growth of the individual in all directions.

It is to be understood, however, that this want of growth

PLATE XLII.

FIG. 71.—SECTION OF A TESTIS FROM A CASE OF ATCLEIOSIS, OR
GENERAL ARREST OF GROWTH. (× 25.) (HASTINGS GILFORD, F.R.C.S.)

(Compare with Fig. 15.)
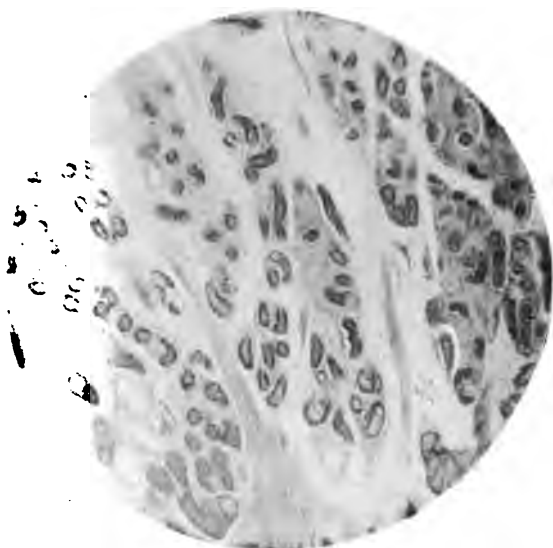
FIG. 72.—SECTION OF A TESTIS FROM A CASE OF ATCLEIOSIS.
(HASTINGS GILFORD, F.R.C.S.)

It resembles that met with in early infancy, tubules being fairly numerous
and interstitial tissue not excessive.

may be due to some prior cause, which is also acting as the factor in the imperfect descent.

3. When both testes are arrested, and yet they are fully developed—a condition which does occasionally occur— there is no want of bodily or other development.

In endeavouring to determine the cause of the relationship between imperfect development of the arrested testes and the want of general growth of the body, or of efficiency in certain physiological functions, some light may possibly be thrown by a careful study of the microscopic appearances of sections of the arrested glands.

As has been pointed out, it is an interesting fact that the testis of a child before puberty is entirely devoid, or nearly completely so, of certain cells lying in the spaces between the seminiferous tubules. These interstitial cells put in an appearance at or about the period of increased sexual development of the subject.

It has been further shown that although in cases of double arrest of the testis both glands may be wholly incapable of producing spermatozoa, yet the owner of them may develop full virile power, but will remain for ever without the ability to procreate. There is the possibility that these interstitial cells have the function of producing a so-called 'internal secretion,' and that this substance, whatever it may be, plays an important rôle in the proper and full development of the body.

That there is some relationship between 'internal secretion' of organs and the growth and division of cell elements gains some support from the fact that in a certain proportion of instances where double oöphorectomy has been performed for recurrent or inoperable carcinoma of the mamma, particularly in women before the climacteric, there has been a very noticeable change in the constitution of the malignant deposits.

In some of these cases the growths have become profoundly modified within a few days of the removal of the ovaries, and in others they have entirely disappeared, not to return.

Then, again, there is the well-known fact that complete

9—2

removal of both ovaries leads to diminution in the size of the uterus, uterine atrophy; or removal of both the testes causes diminution of both sides of the prostate gland, atrophy of the prostate.

Each of these operations is liable to be followed by severe 'nerve storms,' in which the patient may for the time being become quite irresponsible for his or her actions. On the other hand, supposing that in the male the vasa deferentia alone are severed, such nervous phenomena are not usually in evidence, and in such conditions, although the testis does atrophy on the side of the section, yet it remains still present, and probably capable of producing its internal secretion.

Further, a removal of both the ovaries, and also of both the testes, tends to a considerable alteration in the amount of adipose tissue of the body, the patients, as a rule, becoming much disposed to accumulation of fat in the subcutaneous tissue.

The subject is one full of suggestion, but one which requires a large amount of clinical, physiological, and pathological study in order to completely elucidate it.

Looking at the matter of the association of imperfect descent with want of proper growth, it must be remembered that both the under development and the faulty migration may each be due to some want of ability of the subject to fully develop. Such a condition is well seen in instances of cretinism in the male, for here not only is the want of bodily growth dependent upon a particular cause, but also the arrest of the testes, which nearly always occurs, is undoubtedly the outcome of the same factor.

Many cases are on record in which imperfect descent of the testis has been accompanied by actual bodily deformities. Among the more interesting and important of these are :

1. The occurrence of incomplete descent with absence of one of the kidneys.
2. The coexistence of talipes, of spina bifida, of cleft palate and talipes.
3. Non-descent of the cæcum into the right iliac fossa.

PLATE XLIII.

FIG. 73.—-A SINGLE KIDNEY LYING IN THE PELVIS, ASSOCIATED WITH
ARREST OF DEVELOPMENT AND TRANSIT OF THE RIGHT TESTIS.
(GODARD.)

The connection between the passage of the cæcum into the region of the right iliac fossa and the migration of the testis into the scrotum is intimate. In those instances where the cæcum has failed to reach the normal resting-place, the testis on the right side, and sometimes also on the left, has not passed into the scrotum.

As has been shown, the gubernaculum testis has anterior attachments to the cæcum, etc., and these share in the drag produced by the fibres of this cord.

In those cases where the cæcum has not reached the iliac fossa there has been an arrest in its so-called descent, while in those instances where there is a congenital cæcal hernia there has probably been an excess of the normal traction.

4. Ectopia vesicæ is almost always, when it occurs in the male subject, associated with imperfect descent of the testes, which, as a rule, lie in pouches on either side of the extroverted bladder. Not infrequently there is a hernial protrusion into the processus vaginalis of the arrested glands.

5. In one case, at least, there has been a double penis associated with imperfect descent of the testis.

There does not appear to be any evidence that arrest of the testes is accompanied by a failure in the development of the tonsils, just as there is none to justify the belief that has been held by some that excision of the tonsils is liable to be followed by atrophy of the testes.

CHAPTER IX.

FAILURE OF SEXUAL DEVELOPMENT DEPENDENT UPON THE IMPERFECT DESCENT OF THE TESTIS.

THE influence of the descent and development of the testis upon the formation and growth of the accessory genital structures in the male is marked. The chief organs to be affected are the prostate, the vesiculæ seminales, Cowper's glands, and the penis.

Prostate.—When both the testes have failed to arrive in the scrotum, provided that they also show want of proper development, the prostate is usually small—that is to say, it does not increase in size at the onset of puberty, remaining always in its puerile condition ; its fibrous tissue appears to be added to, and its glandular tubules are never fully developed, being represented by branching fissures, doing duty for ducts, and lined by a single layer of flattened cells. The intervening or intertubular connective tissue is hypertrophied, and there are but few non-striated muscular fibres to be seen.

The Vesiculæ Seminales and the Vasa Deferentia, either unilaterally or bilaterally, according as to whether one or both of the testes have failed to gain their seat in the scrotum, show evidence of want of development, and appear almost as if they were absent in some instances. The vesicles are small, very sacular, and devoid of secretion.

Cowper's Glands habitually fail to become of normal size in cases where the testes have not passed into the scrotum. The **penis** is, as a rule, small, flaccid, and appears shrunken in those instances in which both testes are wholly retained and undeveloped.

PLATE XLIV.
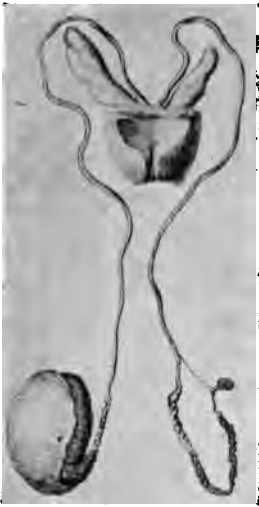
FIG. 74.—ABSENCE OF LEFT
TESTIS, WITH IMPERFECT
DEVELOPMENT OF COR-
RESPONDING VESICLE.
(GODARD.)

FIG. 75.—SPURIOUS HERMAPHRODITISM,
SHOWING TESTES IN LABIA.

FIG. 76.—INTERNAL GENITAL ORGANS OF A CASE OF TRANSVERSE
HERMAPHRODITISM.

(St. Bartholomew's Hospital Museum, No. 3671B. 'Transactions of the
Pathological Society of London,' vol. xlv., p. 102.)

Not infrequently there is a want of the proper attainment of manly characteristics. The hair about the pubes shows a feminine arrangement, the pelvis tends to assume the form seen in the female, and the larynx and voice remain as in the boy.

Occasionally the mammary' glands are somewhat hypertrophied.

In a few instances sexual perversion has been noticed.

Hermaphroditism in its Relationship to Imperfect Descent of the Testis.

Hermaphroditism may be classified as true and spurious. In both varieties, but particularly in the more common form of spurious, it is very usual for the testicular gland to remain either completely or imperfectly descended.

In **True Hermaphroditism** there is present one or more testes and ovaries, or glands which are a combination of both organs. Thus, it is possible to have at least three forms of this variety:

1. *Unilateral.*—That in which there is one ovary or testis on one side with an ovary and testis on the other.

2. *Bilateral.*—That in which there is an ovary and a testis on both sides.

3. *Lateral.*—That in which there is an ovary on one side and a testis on the other.

In a recent collection of thirty cases of true hermaphroditism, comprising three of unilateral, nine of bilateral, and eighteen of lateral, in eighteen the position of the testicular glands are definitely mentioned, and out of these eight, or nearly half, were either within the abdomen or else in the inguinal canal. It is probable that had the site of the glands in the other twelve been indicated the same proportion would have held good.

In **Spurious Hermaphroditism** the condition of imperfect descent is present in even a greater proportion. In these cases, while there is the external appearance of the organs of generation of one sex, the internal generative apparatus has the characters of the opposite sex.

The relationship between the imperfect descent and the abnormal development is perhaps more readily seen and understood in this type than in the former groups. Most of these instances present themselves as the state of the external parts of generation partaking the form more or less of the female, while the internal are those of the male. In addition to this variety, there are those forms of complex hermaphroditism in which there is a mixture of the organs of both sexes externally and internally, as, for instance, that class of case in which, although there are testes within the abdomen, there is also a uterus and associated parts, but no ovaries.

The question as to the position of the sexual glands in instances of spurious hermaphroditism is one of some importance. In many of the recorded cases there have been swellings found in the inguinal canals, which have been the glands, generally the testes, arrested at this spot. In others the organs have been found in the bifid scrotum or in the parts that correspond to labia majora.

It is particularly to the swellings in the inguinal region that attention will here be directed.

Where the external organs are those having the appearance of the female, more or less developed, a tender, oval, and firm tumour occurring in one or both inguinal canals is very suggestive of a herniated ovary. There are, in fact, several instances on record in which the body has been removed under the impression that it was such, and it was only after examination with the microscope that the true testicular nature has been proved. It is doubtful, in fact, whether the opposite condition—namely, that in which ovaries are found in the inguinal canal, with the external organs such as would lead to the presumption that the individual was a male—is at all common, though probably not unknown.

Therefore, it may be stated that, supposing there are bodies lying in the inguinal canals, associated with some doubt as to the sex so far as the external organs are concerned, it is safest to consider that the person is a male rather than a female.

The question, then, that naturally arises is, Has this imperfect descent of the testicular gland any bearing upon the abnormal conditions of the external generative organs ?

It is a fact that in certain other cases where the testes have failed to reach the scrotum the penis has remained so small as to simulate an enlarged clitoris, and the scrotum has been very imperfectly developed, almost rudimentary, and with but little raphé present, and a degree, more or less pronounced, of hypospadias has existed.

A little further development of the same tendency to an abnormal state of the parts and there is produced all the female characteristics of transverse hermaphroditism.

Such a condition may, therefore, be the outcome of some influence dependent upon the imperfect descent of the testes, or the failure to migrate on their part and the abnormal features of the external genitals may both be the result of some prior cause.

INDEX